

THE GRAY ORCHARD HOUSE,
CANTON, MASSACHUSETTS,
NEW ENGLAND STOREHOUSES,
BOSTON, MASSACHUSETTS,
CANTON, MASSACHUSETTS.

JOHN H. HARRIS.

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**THE GRAY-CHEEKED THRUSH,
CATHARUS MINIMUS, AND ITS
NEW ENGLAND SUBSPECIES,
BICKNELL'S THRUSH,
*CATHARUS MINIMUS BICKNELLI***

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CATHARUS MINIMUS, AND ITS
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BICKNELL'S THRUSH,
*CATHARUS MINIMUS BICKNELLI***

Joe T. Marshall

Department of Vertebrate Zoology
National Museum of Natural History
Smithsonian Institution, Washington, D.C. 20560, USA

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FOREWORD

Midway during the writing of this report, Bicknell's Thrush was declared a species separate from the Gray-cheeked Thrush—a move for which I was partly responsible. But like George Wallace, I have written this paper always keeping the data and observations separate for the three populations: Northern Gray-cheeked Thrush, Newfoundland Gray-cheeked Thrush, and Bicknell's Thrush. Thus the information is accessible to all parties whether they regard *aliciae*, *minimus*, and *bicknelli* as subspecies or combine *aliciae* and *minimus* into one species and *bicknelli* into another or if, like Wallace, they regard *minimus* and *bicknelli* as the only two subspecies of the Gray-cheeked Thrush, with the Newfoundland form in some respects an intermediate. It is the last course that I now espouse, but not in a way to confuse the presentation.

RÉSUMÉ

An ornithological masterpiece consisting of a life history added to a taxonomic revision based upon specimens already in museums was published by George J. Wallace in 1939. It dealt with the Gray-cheeked Thrush (*Catharus minimus*) and its New England subspecies, Bicknell's Thrush (*Catharus minimus bicknelli*). The field study by Martha and George Wallace in 1935 was of a large but spread-out population of the bird on Mount Mansfield, Vermont. Previously, the only place where any population of the complex had received more than passing attention was the famous Seal Island, Nova Scotia, that sheltered the largest continuous population of *bicknelli* known before or since. Arthur Cleveland Bent furnished his field notes on Seal Island to Wallace, who incorporated them into his dissertation. When subspecies names later lost favor with American ornithologists, Wallace's treatise and the bird were obliterated from contemporary literature. The 1983 North American checklist has no mention of a New England population of the Gray-cheeked Thrush wintering on Hispaniola (*bicknelli*). [Corrected by AOU 1998, the seventh edition.]

In 1981 I commenced field observations designed to confirm Wallace's work on Bicknell's Thrush. By back-packing to timberline at one or more representative mountains in every state and province credited by Wallace as hosting breeding colonies (on the basis of preexisting specimens and literature), and by finding the bird on its wintering ground in the Dominican Republic, I validated his conclusions, which deserve reinstatement. I embellish the Wallacean concepts with the first, positive, hand-held identifications of *bicknelli* on definite summer territories on Cape Breton Island, Nova Scotia, and in New Brunswick.

Unfortunately, Bicknell's Thrush is now gone from all its sea-level sites—the North Shore of the Gulf of St. Lawrence, Magdalen Islands, and the Nova Scotia localities of Seal Island, Mud Island, and Cape Forchu. It is also extinct upon Greylock Mountain, Massachusetts. Tomás Vargas and I found the secretive Bicknell's Thrushes wintering in the Dominican Republic in a variety of natural vegetations, including a piece of secondary forest in downtown Santo Domingo. We used extremely faint, taped songs and calls to evoke the strong territorial response of winter. Songs from Alaska, Newfoundland, and New England worked equally well. Eastern Cuba should be searched using the same method. Spectacular resumption of vocalizing by entire families of Bicknell's Thrush in September, after the molt but before migration, is a promising gauge of reproductive success and total population on any one mountaintop.

In June 1968 and again from 1980 to 1995, I studied the other populations of *Catharus minimus* during their nesting seasons in Siberia, Alaska, and Newfoundland. I encountered them briefly as migrants in Costa Rica. These populations of

large gray-cheeks were grouped by George Wallace under the subspecies name *Catharus minimus minimus* although he referred to them under separate common names of Northern Gray-cheeked Thrush (for Alaska) and Newfoundland Gray-cheeked Thrush. In museums I confirmed Wallace's conclusions on geographic variation in size: Alaskan and Newfoundland birds are large (*minimus*), with wing chord mostly more than 100 mm; New England birds are small, with wings mostly less than 96 mm. No intervening, intermediate populations have been found, although both Henri Ouellet and I searched the north shore of the Saint Lawrence Gulf for them. In museums I tried to find molting birds still on the breeding ground for a look at the fresh fall feather colors. These and a large series of fall migrant Newfoundland Gray-cheeked Thrushes and Bicknell's Thrushes (Smithsonian Institution) do not show the color phases claimed with considerable misgivings by Wallace (1939). I merely confirm what is already known from Wallace (1939) and Ouellet (1993b) that the Alaska to Québec *aliciae* is olive-gray, Newfoundland *minimus* olive-brown, and New England *bicknelli* is a deeper, richer brown. In fresh plumage all three have reddish tail, but redder in the same order that the backs are browner. I also analyzed the eight and one-half hours of vocalizations that I recorded in the field. Although the Newfoundland Gray-cheeked Thrush is large, its habitat preference and color (including the amount of buff on the chest) is intermediate between Bicknell's Thrush to the south and the Northern Gray-cheeked Thrush to the west. Even the song of Bicknell's Thrush differs only through a switch in position between the last two principal sections of the *minimus* song. Therefore I find no basis for accepting *bicknelli* as a full species except that mitochondrial DNA analysis points in that direction. I do not question the value of determining genetic distance from mitochondrial DNA; rather, I question the calibration. Genetic distance from *minimus* to *bicknelli* should be calibrated by comparison of mitochondrial DNAs between *Catharus minimus* and its obvious closest relative, *Catharus fuscescens*, the Veery, as I have harped on to my white-coated colleagues for years. These are true species that can be distinguished in the field and that actually overlap in their nesting distributions.

The habitat of Bicknell's Thrush is now the impenetrable thicket of spruce and balsam fir at timberline of mountaintops from Southern Québec, especially the Gaspé, southward at least to Slide Mountain in the Catskills of New York. On mountains harboring major populations at timberline, such as Carleton, Katahdin, Whiteface, and Mt. Washington, some individuals occupy territories at somewhat lower elevations than timberline, where one can walk beneath the windswept spruce canopy; still farther down the slopes, some Bicknell's Thrushes overlap Swainson's Thrushes, *Catharus ustulatus*, in tall conifers. Formerly *bicknelli* also lived in stunted spruce and balsam fir near sea level on the Magdalens and on the shores and islands of southwestern Nova Scotia. Three singing males collected by Olaus J. Murie and George M. Sutton along the north shore of the Gulf of St. Lawrence and a summer female collected by C. W. Townsend may have represented a breeding population in what is now the huge geographic gap between Bicknell's Thrush and the Newfoundland Gray-cheeked Thrush. I say "may have" because the habitat does not look suitable either to me or to Dr. Henri

Ouellet and no field notes or tradition remains to show that the four specimens, identified by their short wings, represented a substantial population.

The Newfoundland Gray-cheek seemed to me entirely capricious in its choice of occurrence, although it is limited to few habitat choices in that province. I found none in the birch and willow brush above timberline, nor in riparian willow thickets anywhere. The scattered colonies I found were in seaside or lakeside stunted conifer thickets, timberline conifers, and tall spruce and fir forest. In Siberia I found the Northern Gray-cheeked Thrushes in a shoulder-high willow thicket surrounded by tundra at the head of Provideniya Fiord, far north of the limit of trees. On the Alaska side incredible abundance is achieved in dwarf birch and willow brush or a combination of the two—all well above timberline but below tundra. The Northern Gray-cheek also affected willow thickets and spruce groves at a lower elevation in and around Fairbanks.

The high-pitched, screeching calls of *Catharus minimus*, designed to be heard above the tempest and across the sky during nocturnal migration, are infinitely varied. Study of them is complicated by one's inability ever to see the calling bird or to obtain the slightest clue as to what behavioral interactions, if any, are being vocally expressed inside the krummholz or willow thicket. And in one performance of intense calling (I would say inspired calling) the bird will change radically the pitch, timbre, and inflection of its voice with no change of position or interaction with other birds. Although I can classify the calls by their sonagrams and timbre into five categories, the constant improvisations by the birds run into about a hundred sub-categories, some of which I have never again recorded at another time or place.

Unlike the closely-related Veery, all of whose songs sound the same to me, each individual Gray-cheeked and Bicknell's Thrush has unique songs, like fingerprints. I have a few recordings of the same song on two adjacent territories, which I attribute to nestmates or father and son. I have found one instance of two birds with the same three songs, one at the University of Alaska, Fairbanks, in 1968, the other at Sithylemenkat Lake (also called Round Lake, half-way between Fairbanks and Bettles) in 1980. After part I, the introductory chucks or a lisping note (both of which are heard only between songs and are not used as independent call notes), a song of the Northern and Newfoundland Gray-cheeked Thrushes consists of hundreds of notes in two obbligato voices made by the two independent syringes. Part II is complex, of several phrases; part III is high in pitch and rises at the end; part IV is lower in pitch and of descending inflection. The Northern and Newfoundland Gray-cheeked Thrushes sing the parts in that order so that their songs end with a downward turn unless they leave off part IV. When they leave off part IV the song sounds like a Bicknell's Thrush.

Bicknell's Thrush, with the same parts I and II, switches parts III and IV so as to end with an upward tilt, as can be heard in the field during the brief song period at dawn and late evening during June, July, and again in mid-September (after the molt but before migration). I found an individual at Mt. Mansfield, one of whose songs, of normal length, ends at fairly low pitch with a slightly down-turned trill so as to sound like *minimus*.

Each individual male of Northern, Newfoundland, and Bicknell's Gray-cheeked Thrushes has three or four songs in its repertoire, none of which is

allowed to be uttered twice in succession. A few males end all their songs the same way, but most have at least one song that is as different as if it were from another bird. That makes it impossible to sort out individuals indulging in an evening songfest while trading places unseen within the dense conifers. Even with two microphones for stereo, if the birds move before singing their third song, all is chaos except for overlapping songs of two individuals. Up to now, in none of the choruses have I recorded enough overlapping songs to clarify.

Differences between the Alaskan, Newfoundland, and New England populations of *Catharus minimus* are not commensurate with those between other full species within the same genus. Major qualitative differences separate *Catharus occidentalis* from *Catharus frantzii* just as the Veery is different from its closest relative, the Gray-cheeked Thrush. The slight differences in body size, color, song, and habitat among the far-flung populations of *Catharus minimus* are differences of degree only. These birds are making the best of it among the limited habitats available to each population in its far north or commensurate timberline area. Dense, stunted vegetation of waist or shoulder height best characterizes the habitat choice of each population. I conclude that the most scientifically accurate means of summarizing the data amassed from this study in the taxonomic sense is to follow George J. Wallace's reasonable advice to regard the Northern and Newfoundland Gray-cheeked and Bicknell's Thrushes as one species, *Catharus minimus*, with two subspecies: *Catharus minimus minimus* for the combined Northern and Newfoundland Gray-cheeked Thrushes, and *Catharus minimus bicknelli* for Bicknell's Thrush as follows:

***Catharus minimus*, Gray-cheeked Thrush**

Catharus minimus minimus, Northern and Newfoundland Gray-cheeked Thrushes

Northern Gray-cheeked Thrush, grayish olive upperparts, grayish mandibular ramus; large size (as with the Veery); part III of song high-pitched and inflected upward, part IV low-pitched and descending; eastern Siberia and Alaska in dwarf willow thicket to Manitoba and northern Québec, winters in South America, migrates in mid-continental United States.

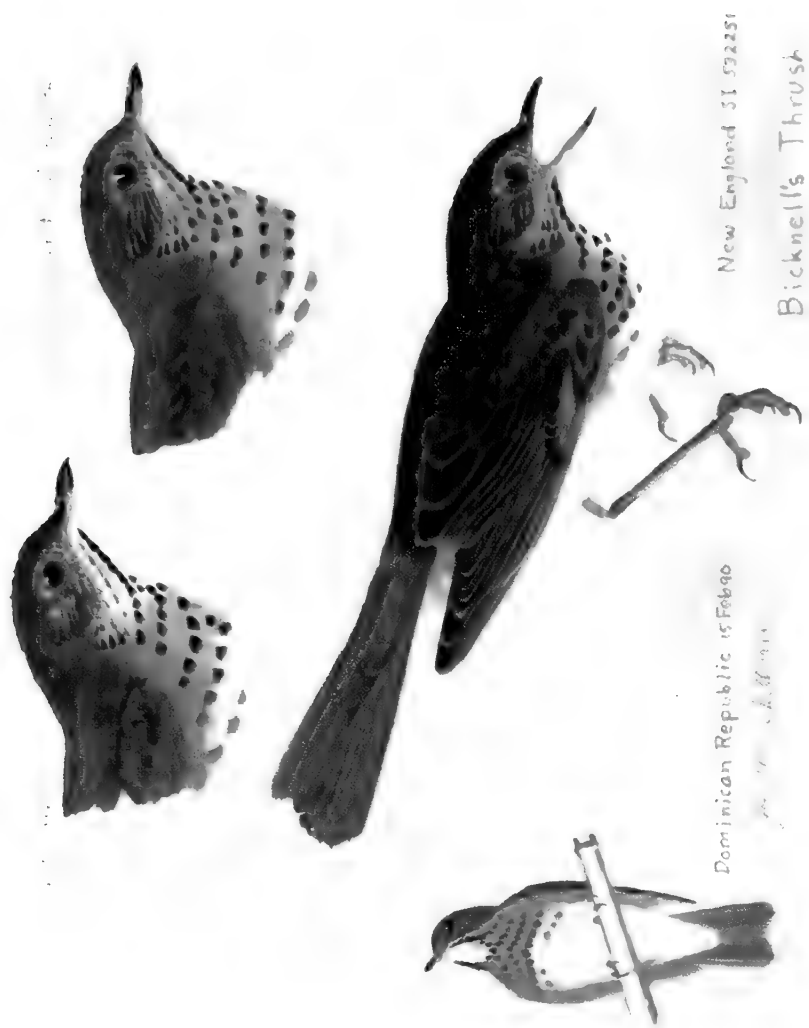
Newfoundland Gray-cheeked Thrush, upperparts slightly browner grayish olive and intermediate towards *bicknelli*, grayish mandibular ramus; not quite as large size; part III of song varied but not low, part IV low-pitched and descending; Newfoundland in spruce and fir forest and adjacent Québec and Labrador across the Strait of Belle Isle, winters in South America, migrates along the Atlantic states east of the Appalachians.

Catharus minimus bicknelli, Bicknell's (Gray-cheeked) Thrush

Upperparts brownish olive, yellow mandibular ramus, small size; part III of song low-pitched and inflected downward, part IV high-pitched and rising; Nova Scotia and southern Québec to New York chiefly in timberline thicket of spruce and fir, winters on Hispaniola, migrates along the Atlantic states east of the Appalachians.

The northern populations (*aliciae* and *minimus*) are not identifiable in the field and are only barely distinguishable by color in fresh fall plumage in the museum. But the Newfoundland birds (*minimus* vera) are intermediate in many respects between the Alaska form (*aliciae* of pre-Wallacean tradition) and Bicknell's Thrush. In the field, with proximity, excellent lighting, and another thrush in view for size comparison, it would be possible to separate Bicknell's Thrush by the yellow base of mandible and small size. Back and tail color would be of no use, especially in worn summer plumage. But who ever sees a member of the *aliciae-minimus-bicknelli* complex well enough or long enough to use color traits—in the gloom, in the pouring rain? In all my years of searching for this thrush, from 1968 to the present, I have only the one close view in sunlight of the gaping bird, still as a statue, shown on Color Plate 1.

If at least two out of three consecutive songs end at high pitch with rising inflection, then the singer is indeed a Bicknell's Thrush. The certain means of substantiating an occurrence of Bicknell's Thrush are to tape record at least three of a male's consecutive songs and then catch him and measure the chord of the unflattened wing from wrist to tip of the eighth (longest) primary.



COLOR PLATE 1. Coloration, in fall plumage, of Gray-cheeked and Bicknell's Thrushes. The color differences shown that distinguish Bicknell's Thrush (*Catharus minimus bicknelli*, lower two) from the Gray-cheeked Thrush (*Catharus minimus minimus*, Northern population "aliciae," upper left and Newfoundland minimus, upper right) are mainly the darker brown back and yellow mandible of the smaller Bicknell's Thrush. Watercolor by Joe Marshall based on three Smithsonian Institution specimens in fresh fall plumage, field sketch of a wintering bird just released from the net (lower left, with symmetrical spotting, compare Marshall 1988), and field notes concerning a belligerent individual at French Mountain. This bird (lower right), having just uttered a loud rattle call, still threatens a disappearing intruder upon its territory and holds this posture and gaping mouth for several seconds in total silence. The bright yellow mouth lining is displayed. Presently the thrush dashes away in full pursuit. The three larger figures are drawn to the same scale in which the right wing shown of *bicknelli* is 91 mm. Its secondary flight feathers are in their natural position relative to the primaries. If more of the wing tip is exposed than this, then the wing chord measurement will be excessive, owing to pressure upon the primaries by the secondaries that have been left telescoped down the ulna by incompetent preparators.



J. h. hyemalis
Pink-bellied Junco



J. h. caniceps
Gray-headed Junco



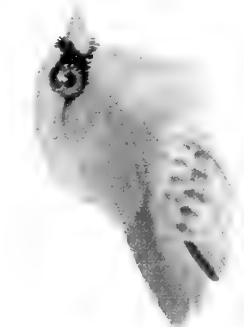
J. h. dorsalis
Red-backed Junco



Junco phaeonotus
Yellow-eyed Junco



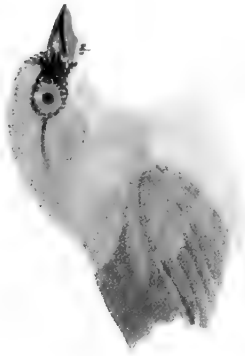
J. h. hyemalis
Pink-bellied Junco



J. h. caniceps
Gray-headed Junco



J. h. dorsalis
Red-backed Junco



Junco phaeonotus
Yellow-eyed Junco

See Plate 17, 18

COLOR PLATE 2. Juncos of the United States, showing how colors of the eye, bill, hood, back, and wing coverts can be used to key out species and subspecies in the field. These of course are major subspecies, not clinal ones. Clinal populations, interesting as they are, do not deserve a scientific name because our system cannot handle two levels of subspecies.

INTRODUCTION

George J. Wallace, late professor of ornithology at Southern Michigan State University, achieved fame for inspiring Rachel Carson's book, *Silent Spring* (1962) through his study of the effects of DDT upon the American Robin (*Turdus migratorius*). Few recall that earlier he had published a doctoral thesis (Wallace 1939) that for several decades was considered a model of research upon a single species of bird. Dealing with the Gray-cheeked Thrush (*Catharus minimus*) as a whole and with Bicknell's subspecies (*Catharus minimus bicknelli*) in particular, Wallace corrected the misidentifications by some of our greatest ornithologists, who had confounded the bird with the Olive-backed Thrush (*Catharus ustulatus swainsoni*). Wallace (1939) offered a critique of the error-ridden literature, proposed a correct taxonomy based on careful reidentification of the three holotypes, detailed the breeding and winter distribution from the evidence of specimens already existing in museums, and presented a life history based on his and Martha Wallace's nest observations of a large population all over Mount Mansfield, Vermont.

The purpose of this report is to reinstate Wallace's findings, to emphasize their correctness, to round out the summer and winter distribution from personal observations, to analyze the wild and strange songs, and to sound the alarms about destruction of the nesting habitat—principally the red spruce, *Picea rubens*—by acid clouds from the west. My qualifications are my personal field study of the entire species and tape-recording of its calls and songs in Siberia, Alaska, Newfoundland, every northeastern province and state in its breeding range, the winter range in Hispaniola, and part of the migration route in Costa Rica. I have yet to search the South American winter quarters for *minimus* and eastern Cuba for possible wintering *bicknelli*. I also visited collections in North American museums in order to confirm Wallace's wing measurements and identifications of all the Bicknell's Thrushes I could find. I repeat his list of specimens with a concordance between the present museum numbers and those used by Wallace (1939) because the private collections he studied are all now in major museums and catalogued with different numbers. They have been difficult to trace. At the Smithsonian Institution I also examined all Alaskan and Canadian specimens of the Gray-cheeked Thrush with special reference to molting specimens still on their hatching grounds. I do not repeat Wallace's long lists of specimens of Northern and Newfoundland Gray-cheeked Thrushes, but I strongly urge curators to take those lists seriously, to find missing specimens placed with the wrong species in their museums, and to put Wallace's identifications upon the labels and into their data bases. Then they can use the known specimens identified by Wallace to help identify and correctly name their specimens added since 1939. This is

such an extremely tricky business, owing to past name changes and the similarity of Gray-cheeked Thrushes to some specimens of western Veerys (*Catharus fuscescens salicicola*) that I must devote an entire section of the discussion [curating] to this problem. Briefly stated, the problem is that the three scientific names, *aliciae*, *bicknelli*, and *minimus*, have at different times applied to different populations. Therefore, the name on the label of a museum specimen depends mainly on when the label was written. The curator who groups specimens with the same scientific name on the label will wind up with composite taxa, as is found in museum after museum.

Adherence of Bicknell's Thrush to the interior of conifer thickets in summer and low profile on its winter territories makes it perhaps the most difficult to see of all the world's common songbirds. It has never been correctly portrayed by bird artists (Parkes 1954) or photographers. Nothing is known of its normal behavior except that observed by nest watchers. Therefore I must report such activity as I was lucky enough to see (Color Plate 1, for example) and I document facts as they are presented, in narrative style, so as to avoid the vagueness, error, misinterpretation, and anonymity that pervade undocumented state and provincial handbooks, checklists, tables in ecological treatises, and atlases.

CONTENTS OF THIS BOOK

The primary source materials on Bicknell's Thrush are discussed first: Arthur Cleveland Bent's notes from Seal Island, Nova Scotia, that Wallace (1939) used; Martha and George Wallace's nesting study at Mount Mansfield, Vermont; the list of specimens that Wallace examined (Wallace 1939: Appendix—present museum numbers are in Appendix 1 here); and the tape recordings by Arthur A. Allen and Peter Paul Kellogg at the Library of Natural Sounds, Cornell University. Then the contribution of Wallace (1939) and the reception it eventually suffered are discussed followed by a review of literature subsequent to publication of Wallace's book. I present a chronology of my own studies of the species, *Catharus minimus*, with both its subspecies. I then detail the methods I used. My results of field observations are presented from west to east and north to south, beginning with Siberia and ending with Slide Mountain, Dominican Republic, and Costa Rica. The last part of these observations, covering Bicknell's Thrush, is in the same format as Wallace (1939) so that the reader who has in hand the Wallacean opus can follow a comparison of present with past, from one mountain to the next in order from north to south by state or province covering the breeding distribution, followed by the winter area. I then analyze the habitats occupied by Gray-cheeked Thrushes from Siberia to Newfoundland in comparison with those of Bicknell's Thrush in New England, southern Québec, the Maritime Provinces, and Hispaniola. Vocalizations are then compared and analyzed by means of sonagrams. My revision and curation of just the Smithsonian collection of *Catharus minimus* happens to coincide in its outcome with the larger analysis by Wallace (1939). I close with my view of the taxonomic relationships of Bicknell's Thrush and a call for recognition of field-identifiable subspecies as the sole recipients of the scientific trinomial. Examples of such subspecies familiar to me from other genera are in Appendix 2.

Appendix 1 lists the *bicknelli* specimens again, but this time by museums in alphabetical order, as an inducement for curators to seize a second opportunity to correct their identifications—for which they achieved failing marks in 1939. My contribution is illustrated by a color plate of the birds, photographs of habitats, maps and sketches of my mountain-top observation sites, and sonagrams of the calls and songs. Tables compare the songs and calls among the three populations.

PRIMARY SOURCES

The primary source on the historic status of Bicknell's Thrush consists of the museum specimens carefully identified and listed in an appendix by Wallace (1939). Because the private collections have since been incorporated into major museums, the new museum number is given and additional specimens that have come to light are listed in Appendix 1. No collectors' field notes are found that would indicate how substantial was the population from which a specimen came. This is especially bitter for the North Shore of the Gulf of St. Lawrence, where the one Olaus J. Murie specimen (head of Grand Portage on St. Margaret River, 14 June 1917) and two George Miksch Sutton specimens (Point Natashquan, 2 June 1928, and mouth of Little Mecatina River, 27 June 1928) may well have represented a substantial population capable of intergrading with *minimus* only a stone's throw to the east. None of Sutton's autobiographical works mentions Bicknell's Thrush although W. E. Clyde Todd's 1928 expedition to the North Shore, of which Sutton was a member, is covered in Sutton (1980:183–185). No field notes for these two expeditions, 1917 and 1928, are found at the Carnegie Museum of Natural History for Murie, Sutton, or Todd although Todd would have incorporated *all* his field observations into his Labrador book (Todd 1963), according to Kenneth C. Parkes (pers. comm.).

An additional primary source for historic occurrence is a small but priceless collection of songs at the Library of Natural Sounds, Laboratory of Ornithology, Cornell University, recorded by Arthur A. Allen and Peter Paul Kellogg and totalling 19 minutes and 35 seconds. Because these songs were never sorted between Bicknell's Thrush (*Catharus minimus bicknelli*) and the Gray-cheeked Thrush (*Catharus minimus minimus*) their importance went unrecognized until Henri Ouellet acquired copies (Ouellet 1993). Dr. Ouellet and I both listened to them and we agree from different inflection of the terminal phrase that the Gray-cheeked Thrush occupied La Tabatière on the north shore of the Gulf of Saint Lawrence, Québec. Unfortunately, the LNS songs of the Bicknell's Thrush colony that once thrived at the top of Greylock, Massachusetts, are not really recognizable, owing to the tempestuous wind. The second song on LNS 4210 does barely provide a sonagram that shows the Bicknell's Thrush signature of grace note and upward inflected terminal phrase. Literature and an extant specimen (MCZ) adequately document this former colony, however.

Finally, I uncover from the Caribbean Islands some midwinter banding records of "Gray-cheeked Thrush, *Catharus minimus*" that were never presented because the subspecies *bicknelli* and the fact that it winters on Hispaniola had disappeared from the checklist and the value of these data was unappreciated. The banders provided me with wing measurements that prove their birds were *bicknelli*, although some are

a trifle long and one wonders if in the heat of battle at the nets banders are apt to flatten the wing while measuring it.

For those interested in nesting behavior I should add that Arthur Cleveland Bent furnished his nest studies on Seal Island, Nova Scotia, to George Wallace. I have not traced Bent's notes but they are well reported in his own "Life Histories" (Wallace 1949) and by Wallace (1939). Martha Wallace found 17 nests on Mount Mansfield—an extraordinary feat—that were the core of the life history study. She learned that the females sing on the nest. This is all reported in great detail by Wallace (1939).

Wallace (1939) stifles his irritation at the past literature, which he politely reviews in its entirety and from which not a single, correct fact is obtainable but instead only flowery ramblings, albeit by some of the great names in American ornithology. And thus ends the primary source material. There are no notes, no censuses, no plant collections, no mapped territories. In a telephone conversation on 9 July 1984, Dr. Wallace told me that he had no censuses or mapped territories in his 1935 study. [Ecologists of that period were more interested in behavior and nesting activities than they were in numbers, populations, and occupancy of habitats. I telephoned the chairman of the Zoology Department, Michigan State University, Dr. Donald Straney, and learned that there are no Wallacean field notes archived there or in the University Library. Dr. Straney was in close touch with Wallace's family, which established a Wallace scholarship fund at the University.]

GEORGE JOHN WALLACE

This brings us to George John Wallace himself (Wallace 1939, 1949 *in* Bent's "Life Histories," 1979). He is the only writer ever to have presented the correct, overall picture of the Gray-cheeked Thrush: Its New England race, Bicknell's Thrush, with wing chord measurements of 84–97 mm (extremes), nests in timberline or fog-belt thickets of spruce and balsam fir from the Gulf of Saint Lawrence, Gaspé Peninsula, Magdalen Islands, and Seal Island, Nova Scotia, to the Catskills of New York and thence to Hispaniola for the winter. Bicknell's Thrush migrates south along the Atlantic Coast in late September and early October, seldom occurring very far inland.

The northern race of the Gray-cheeked Thrush, with wing chord from 95 to 108 mm, nests from Siberia to Newfoundland but winters in South America. [Only a negligible number of specimens from the breeding grounds of the northern race, *Catharus minimus minimus*, have a wing chord that falls in the overlap zone of 95 to 97 mm; trouble comes from a few undersized immature female migrants of *minimus* from along the mid-continental migratory flyway.]

Wallace examined and allocated the three type-specimens pertaining to the Gray-cheeked Thrush as follows: *Turdus minimus* Lafresnaye, 1848, from Bogota, Colombia, in winter, is large and dark brown and represents the population that breeds on Newfoundland; *Turdus aliciae* Baird, 1858, a spring migrant in Illinois, is also large, but grayish, representing the population that nests from Siberia to northern Québec; *Hylocichla aliciae bicknelli* Ridgway, 1881, is the small, very in-

tensely dark brown, June-nesting bird from Slide Mountain, New York. Wallace assigns the name *aliciae* to the synonymy of *minima*. He uses *minima* as the name for the whole species as well as that of its northern, large subspecies, the Gray-cheeked Thrush, *Hylocichla minima minima*. This is rendered today as *Catharus minimus minimus* because of generic name change. Ornithologists now realize that there is no difference of generic stature among the spotted northern thrushes (*Hylocichla fuscescens*, *H. guttatus*, *H. minimus*, *H. mustelinus*, and *H. ustulatus*) and their Neotropical relatives in the older genus *Catharus* (*auranti-rostris*, *dryas*, *frantzii*, *fuscator*, *gracilirostris*, *mexicanus*, and *occidentalis*). *Hylocichla* therefore becomes *Catharus* for all 12 species. It is illuminating in this regard to notice mannerisms of the Hermit Thrush used by *Catharus gracilirostris* and elements of its song repeated in *C. frantzii*. As for dropping the euphonious, sentimental *Hylocichla*, Winker and Rappole (1988) defeated Dilger (1956a, b, c) on his own turf by showing that the Wood Thrush does indeed have the mannerisms and hostile displays of the other northern, spotted thrushes and therefore does not constitute a unique genus.

In tables of measurements, migration schedules, color descriptions, breeding distributions, winter distributions, and specimen lists, Wallace (1939) consistently separates the grayer Alaskan population, which he calls the Northern Gray-cheeked Thrush, from the browner Newfoundland population, which he calls the Newfoundland Gray-cheeked Thrush. However he includes both these populations in one subspecies because he does not consider the color difference great enough to merit an additional trinomial, which traditionally and again lately has been *Catharus minimus aliciae* for Siberia and Alaska to northern Québec (Godfrey 1966, Phillips 1991).

Wallace (1939) rendered the scientific name for Bicknell's Thrush as *Hylocichla minima bicknelli*, now known as *Catharus minimus bicknelli*. No other summer specimen of *bicknelli* is as richly colored as is the type. It wears the dark brown colors that most individuals would acquire only by the fall molt, yet it was taken in June. It is very likely this specimen that gave Wallace the idea of color phases. I think it is a fall bird whose label was switched with a summer bird.

Wallace (1949) made an excellent summary for Bent's "Life Histories" of everything he knew about Bicknell's Thrush and Bent (1949:188–199) himself got everything right for the Gray-cheeked Thrush, too, doubtless from Wallace's advice. In the "Life Histories" (Bent 1949, Wallace 1949) the two subspecies are treated simply as Gray-cheeked Thrush and Bicknell's Thrush with distributions combined in the final paragraphs on the Gray-cheek because it is impossible to distinguish them from each other in the field during migration.

As reviewed and quoted in detail by Wallace (1939), Seal Island, off southwestern Nova Scotia, had been the principal study site for Bicknell's Thrush prior to the Wallaces' work in 1935. Their Mount Mansfield study area was only the second, where any concerted observations had been made, for any of the three taxa in the entire little-known species complex. Wallace's (1979) autobiographical reminiscences express chagrin that his bird and its name were summarily dismissed from the list of North American birds. The book (Wallace 1979), illustrated with excellent habitat photographs, sheds more light on the environment

of Mount Mansfield in 1935 than does the dissertation (1939). A conifer thicket apparently suitable for Bicknell's Thrush is shown in back of (uphill from) Butler Lodge, at only 2900 feet altitude—far lower than any Vermont population of today. This thicket was the new growth after a fire burned the vegetation of this mountainside to the ground. While the spruce and firs were still young and dense, their structure would have been suitable for Bicknell's Thrush. I surmise that the birds have been forced to retire far uphill from this area now that a mixed, full-statured forest prevails at Butler Lodge. Martha and George ran Butler Lodge in its first season as rangers for the Green Mountain Club. They charged hikers twenty-five cents a night to stay in the lodge because outside camping and fires are forbidden on the Long Trail. They sold Kool-Aid, candy bars, and fresh-baked blueberry pie to the hikers. Their duties included keeping down the destructive porcupine population, from which they developed a tasty dish of the livers. They evidently never studied *Catharus minimus* again after 1935. In a chapter on the 1968 meeting of the American Ornithologists' Union, Wallace (1979) makes no mention of Gray-cheeked Thrushes. Was I the only delegate who noticed these birds around Moore Hall on the University of Alaska campus, Fairbanks, where we all stayed?

SUBSEQUENT LITERATURE*

[*Author's corrections and asides are in brackets throughout.]

I report here all published accounts of *bicknelli* made by persons who encountered it in the field. I omit derived, anonymous, unattributed compilations such as tabulations in ecologic works, state lists, checklists, and atlases. Compilers of state and provincial atlases whom I asked for proof of the identification of their lowland, low latitude "Gray-cheeked Thrushes" in summer, and whether the birds were territorial or migrating, were unable to produce field notes, photographs, tape recordings, or even the author of a particular observation. I have searched the derived literature for mention of field observations credited to specific persons. I eschew mentioning the rash of articles in birding journals by authors ecstatic over the prospect that they will earn a gratuitous addition to their life list following the elevation of Bicknell's Thrush to a full species by Ouellet (1993). Most of these authors paid no attention to the bird or its precarious populations, especially in Canada, when they thought it was a subspecies that their atlas volunteers could not be expected to identify.

Taxonomic Works

Wallace (1939) uses a system of names from the American Ornithologists' Union Checklist of 1931 wherein each subspecies has its own common name as well as its scientific trinomial, "*Hylocichla minima aliciae* (Baird). Gray-cheeked Thrush . . . *Hylocichla minima minima* (Lafresnaye). Bicknell's Thrush." Dilger (1956c) used Bicknell's Thrush and the yellow base of its mandible as part of his evidence that our four spotted thrushes (leaving out the Wood Thrush, *Hylocichla mustelina*) belong with the seven Neotropical species of the genus *Catharus*.

American Ornithologists' Union (1957) does away with subspecific common names: "*Hylocichla minima* (Lafresnaye): Gray-cheeked Thrush . . . *Hylocichla minima minima* (Lafresnaye) . . . *Hylocichla minima bicknelli* Ridgway." Deignan (1961) comments on the type specimen of *bicknelli* and wonders what happened to the second one taken by Eugene P. Bicknell that same day on Slide Mountain, New York. [Thanks to Ralph S. Palmer, who purchased Bicknell's collection and donated the topotype to Harvard, I can report that it is number 275708 in the Museum of Comparative Zoology (Appendix 1).]

Todd (1963) attempted to distinguish an olive-backed, sea-level "St. Lawrence Thrush" as distinct from the high-mountain, brown *bicknelli* of New York. In June 1901 he had collected two singing *bicknelli* on the Magdalen Islands (Appendix 1) and said he did not hear the same song again until 14 June 1917 at the head of Grand Portage, where he was gratified that Olaus J. Murie "went out and bagged the bird" (Todd 1963:559). In 1928, Todd was on hand when George M. Sutton collected another male at Point Natashquan on 2 June and still another at the mouth of the Little Mecatina River on 27 June (Appendix 1). Todd (1963) had at one time examined two specimens of Townsend, one female from Romaine with wing measured at the Museum of Comparative Zoology by Wallace (1939) at 90 mm (frayed) [not found there in 1992 by Dr. Henri Ouellet (in litt.) nor in 1993 and 1996 by Dr. Raymond A. Paynter, Jr. (in litt.)] and a second female from Cape Charles with frayed wing of 95 mm (Wallace 1939). Todd cites literature for occurrences based on sight or sound at unspecified locations along the North Coast of St. Lawrence Gulf as well as Gabrielson's (1952) numerous sightings at named villages. The specimens and other records wind up as an impressive row of one inland and 13 coastal dots on the map (Todd 1963:557), which convinced Todd that he had discovered a substantial, low altitude, breeding population of small, grayish, *bicknelli*-like thrushes along the entire North Shore of the Gulf of Saint Lawrence all the way to its northeastern limit at Cape Charles. Of course Todd had as good reason, in theory, to expect a population along the North Shore as did Henri Ouellet in 1968 and Mrs. Marshall and I in 1991 because the area intervenes between two thriving subspecies of *Catharus minimus* between which would be expected intergrades. To the chagrin of Dr. Ouellet (1993), Mrs. Marshall, and I there were no birds and the obvious hiatus there between Bicknell's Thrush and the Newfoundland Gray-cheeked Thrush seems due to the lack of suitable habitat both at the beach and in the mountains that never seem to reach timberline. We think that there never was a breeding population between southern Québec and La Tabatière and that the four examples of true *bicknelli* from Grand Portage, Point Natashquan, Grand Romaine, and Mouth of the Little Mecatina River simply overshot their migration destination in extreme southern Québec. If that is not so, then why would Todd and Murie have encountered just one bird in 75 km of supposed prime habitat from 26 May–14 June 1917 that they spent going up the St. Margaret River to Grand Portage? There is simply no way to be sure.

Overriding my grave doubts about a major North Shore population is Kenneth C. Parke's (pers. comm.) assessment of Todd's reasoning. Four specimens in the middle of the nesting season would be ample for Todd to construct a nameable

subspecies. [Of course, Todd was mistaken in thinking his St. Lawrence Thrush occupied the entire North Shore. The tape recordings of Arthur A. Allen and Peter Paul Kellogg from La Tabatière are unquestionably the songs of one territorial Gray-cheeked Thrush, not Bicknell's. The nearest *bicknelli* specimen is from Mouth of the Little Mecatina River, 60 km to the southwest. For the present, I shall adopt this view: Bicknell's Thrush formerly occupied the North Shore of the St. Lawrence gulf as far northeast as the Mouth of the Little Mecatina River, opposite Harrington Harbour, but it has since become extinct there as on all its other former sea-level habitats such as the Magdalens, Yarmouth, Mud Island, and Seal Island. Until at least 1928 there was some sort of contact of the two subspecies or an hiatus between them in the 60 km between Little Mecatina (*bicknelli*) and La Tabatière (*minimus*). There must have been intergradation because all specimens from the Labrador portion of the North Shore are short winged (less than 100 mm). Besides the Thayer female at Cape Charles with frayed wing of 95 mm (Wallace 1939), the four other known specimens (Canadian Museum of Nature) northeast of La Tabatière, where the song of the Gray-cheeked Thrush prevails, are male, Makkovik, 1960, 98.8 mm; L'Anse-au-Clair, 1981, male 97.9 mm, male 97.0 mm, female 95.3 mm (H. Ouellet, data in litt.). I conclude that genes for short wing crossed the 60 km contact zone but the gene for rearranging the last two parts of the song did not.]

[The assumptions of Todd (1963:558) regarding his "*Catharus minimus* subsp. St. Lawrence Thrush" may be disposed of as follows. The many dots on his distribution map other than the five specimens cannot be determined as Bicknell's Thrush because Gillet could not tell its song from that of the Northern Gray-cheek and because all of Gabrielson's birds that were dead and dying from the dreadful winter storm in June were probably Northern or Newfoundland Grey-cheeked Thrush migrants. The supposed olivaceous color of the five St. Lawrence specimens examined by Todd, plus the two from the Magdalens, is of little weight considering that all but one are from middle to late June and July, when plumages of all populations of *Catharus minimus* become grayer and more like each other due to wear and fading. The supposed small size of the entire lot is blighted by the Townsend female from Cape Charles whose wing of 95 mm is too long for *bicknelli* not even considering that it is frayed and was originally much longer when in fresh plumage. Therefore the supposed subspecies that Todd thought should eventually be described was actually a composite of *bicknelli* in the southwest and *minimus* in the northeast.]

[The idea of a distinction between timberline and seaside thickets of spruce and balsam fir is quite strained. Both situations, often classified as krummholz, provide the same habitat from the standpoint of *Catharus minimus* and both are widely occupied by the Northern and Newfoundland Gray-cheeked Thrushes. Formerly both habitats were likewise occupied by segments of the Bicknell's Thrush population. It would not have been astonishing if a subspecific distinction could have been discerned between the habitats because the seaside krummholz encompassed most of the northern enclaves, whereas the timberline habitat shelters those of the south. Timberline of course descends altitudinally towards the north and ultimately becomes the same as the sea-level krummholz.]

Godfrey (1966) influenced succeeding lists by incorrectly crediting the Gaspé as harboring breeding *Catharus minimus minimus* (the Newfoundland Gray-checked Thrush in his terminology): Thus Phillips 1991:94: "Breeds in Newfoundland and I. Petit Miquelon; also on Gaspé Pen., Québec." This undocumented distributional incongruity might have been inspired by the one large specimen out of eight from Percé that were available in the Canadian Museum of Nature at the time that Godfrey wrote his book. It has a winglength of 101 mm (male number 8298, Appendix 1). The other seven specimens are small and are obviously *C. m. bicknelli*. Wallace (1939) regarded number 8298 as a Newfoundland-bound *minimus* that had fallen short in its migration [a reasonable assessment that Godfrey ignored]. The date of collection, 14 June 1915, would presume that this bird was incorporated into the Percé summering colony of Bicknell's Thrush, a strong indication that periodic interbreeding is possible. The same possibility is even better shown by a large midsummer female *minimus* collected at Mt. Washington in New Hampshire on 11 July 1884 (Museum of Comparative Zoology number 324734, wing 101 mm, Appendix 1). Godfrey (1966) and Phillips (1991) recognised *Catharus minimus aliciae* (= the Northern Gray-checked Thrush) as a subspecies more gray on the back than the Newfoundland population, *C. m. minimus*.

Beginning in 1968 and continuing to 1980, Roxie C. Laybourne's (pers. comm. and data in litt. at Museum Section, Division of Biological Resources, U.S. Geological Survey) work with feather identification took her to major museums in the United States, Canada, and England. She took the opportunity to examine North American spotted thrushes and their Latin American relatives for sinuation of the outer webs of the outer primaries because she had discovered similarity in this trait between Swainson's Thrush (*Catharus ustulatus*) and the Alaskan population of the Northern Gray-checked Thrush. She took her cue from Ridgway (1907), who had not developed the concept of incised primaries beyond mentioning two in Swainson's Thrush and three in the others. Mrs. Laybourne found that primaries numbers five to eight are sinuated in the Wood Thrush (*Catharus mustelinus*), Hermit Thrush (*C. guttatus*), and the Latin American species; six, seven, and eight in the Veery (*C. fuscescens*), Newfoundland Gray-checked Thrush, and Bicknell's Thrush; whereas only two primaries, numbers seven and eight, are sinuated in the Northern Gray-checked Thrushes from Alaska and in Swainson's Thrush (*C. ustulatus*). [Actually numerous specimens of western Veerys (*C. f. salicicola*) from Idaho and Washington in the Smithsonian collection likewise have two cut-out feathers, another parallel between *Catharus fuscescens* and *Catharus minimus*, which are obviously each others' closest relative.]

Roxie Laybourne's survey would suggest a division between Newfoundland and Northern Gray-checked Thrushes at the Strait of Belle Isle. However, Dr. Henri Ouellet (data in litt.) later (December 1991) found that the change must take place farther west, for the Québec *minimus* all have three sinuated primaries. Dr. Ouellet's total results from specimens in the Canadian Museum of Nature from Québec on eastward are sinuated five to eight in the Hermit Thrush (25 males, 17 females); six, seven, and eight in the Veery (30 males, 14 females), Northern Gray-cheek (47 males, 31 females), Newfoundland Gray-cheek (9 males, 1 female), and Bicknell's Thrush (30 males, two females); and two (seven and eight)

in Swainson's Thrush (25 males, 14 females). [Actually the number of sinuated primaries could be increased by one, because primary number nine is sinuated for its entire length in all these species. Primaries are counted from the inside out; number ten is the outermost and is shorter than the primary coverts. Number eight is the longest primary in *Catharus minimus* and *C. fuscescens*; it therefore has to be located and deemed whole when you measure the wing. The narrow, distal portion of each sinuated outer web (and the entire outer web of number nine) is edged with whitish. The part of the primaries where the indentation commences overlaps its fellows in a curious and interesting pattern in the middle of the folded wing (Color Plate 1).]

American Ornithologists' Union (1983) eschews subspecies and trinomials altogether: "*Catharus minimus* (Lafresnaye). Gray-cheeked Thrush." This sixth edition of the checklist still has the Gray-cheeked Thrush wintering in Central and South America and only casually in Hispaniola [the destination of perhaps 5,000 to 10,000 birds from hundreds of New England mountaintops]. The seventh edition (American Ornithologists' Union [AOU] 1998: 504–505), treating *aliciae* and *minimus* together as one species (*Catharus minimus*) and *bicknelli* as another has correct breeding and winter ranges and migration routes although both winter distributions include places where the respective taxa are extremely rare. "Stunted deciduous forest" is surely a mistake for part of the *bicknelli* nesting habitat, which is conifers only.

Dalzell (1989) states that Joe T. Marshall hopes to interest the Maritime Atlas volunteers in documenting the range of Bicknell's Thrush, their only endemic taxon. It is distinctive enough to be brought back from the oblivion imposed by the AOU. Again Dalzell (1990) quotes Marshall as saying that *Catharus bicknelli* is a distinct species based on song and morphology; that Allan Phillips is recognizing it as a species for his Volume II of *Known Birds*; and that Henri Ouellet has biochemical evidence of a big genetic difference from *minimus*. [Guilty as charged! But I recant, and apologize if I deflected Phillips and Ouellet from the straight and narrow path. Should I have anticipated that by enticing the atlas people we would wind up with Bicknell's Thrush occurring throughout the length and breadth of every state and province within its summer range?]

My dear friend, the late Allan R. Phillips (1991) recognized the Northern Gray-cheeked Thrush as a subspecies, *Catharus minimus aliciae*, and Bicknell's Thrush as a species, *C. bicknelli* that is "Smaller: Wg usually <96" for Bicknell's Thrush (Phillips 1991:72). It is my loss that in his report on museum specimens of *Catharus minimus* I cannot understand the welter of descriptive terms regarding dull or bright colors of the basal half of the lower mandible, different extent of pale color at the base of the lower mandible, different grays and olives and browns of the back and/or crown, and whether or not the tail is redder than the back. [It is redder in all museum specimens of Veerys, Gray-cheeks, and Bicknell's Thrushes that I have seen.] Plate 2 of Phillips (1991) must be mislabeled because the largest bird on it is the gray one at the top labeled *bicknelli*. A true, tiny Bicknell's Thrush would have more the rich back color of the central figure, which is a good representation of the intended western Veery. Granted that museum specimens fox and fade with time, but if foxing were so disastrous for understanding

Catharus minimus and *C. fuscescens*, then why do Bicknell's and Newfoundland Gray-cheeked Thrushes and western Veerys all have backs so much the same color in fall plumage? I applaud Phillips' warnings about the propensity of museum folk to get their specimens into the wrong species of *Catharus*, but we all have done it. Roxie C. Laybourne and I have reidentified a nice but quite small migrant fall specimen of *Catharus ustulatus swainsoni*, Smithsonian number 404723, that shows the characteristic buff on lores, eye-ring, chest, and ear coverts. The back of the label reads in their respective penciled hands "*bicknelli* A. W." [Alexander Wetmore] and "not good *bicknelli* A. R. P." [Allan R. Phillips]. Phillips (1991:95) goes on to say about the same specimen "Smallest ♀ im seen that I consider *aliciae* [Northern Gray-cheeked Thrush] are 92.7 (Virginia, US 404723) and . . ."! I shun the excuse that we are dealing with occasional hybrids. Phillips (1991:99) implies that my perfectly normal, immature Veery still molting on 14 August might be a hybrid, presumably because of barely emerging, and therefore dark, chest spots. But according to my field notes in the Smithsonian, the bird was netted in probably its own family's nesting territory amidst a huge Veery population in proper Veery habitat on the Port au Port Peninsula that supports no Gray-cheeked Thrushes whatsoever (except for one wanderer that sang in a dooryard at Boswarlos one morning only, 29 June 1981). Its hybrid origin is unthinkable, especially considering the search by Martha Hays Cooper, Elsie Marshall, and me for overlap and hybridization between the Veery and Gray-cheek in Newfoundland. We found the overlap all right at 15 km northwest of Port-aux-Basques, where the two species paid absolutely no attention to each other and had no hint of intermediacy in any calls or songs. Finally, I greatly appreciate the thoughtfulness of Dr. Phillips in explaining to me over the telephone (pers. comm. 21 May 1995) that his otherwise cryptic key can be taken literally for the distinction between Veery and Gray-cheek (all subspecies of each): Veerys have a definite contrast between the tawny sides of the chest and the clear gray flanks, whereas in the Gray-cheeks these parts are more the same and colored brown like the back [except in late summer, see the subsequent account of Slide Mountain, New York].

Dr. Henri Ouellet, in his study of the taxonomy and distribution of Bicknell's Thrush (1993b), has taken full advantage of his unique situation in Québec, which is the only state or province that has flourishing nesting populations of all three taxa of the Gray-cheeked Thrush. In his preliminary report, Ouellet (1993a) provides a most valuable distribution map based on specimens and his field discoveries in Québec, which shows the enormous hiatus between *bicknelli* and the northern forms. In his definitive paper, Ouellet (1993b) designates *bicknelli* a species separate from the Gray-cheeked Thrush. His measurements show that *bicknelli* is indeed small compared to *aliciae* and *minimus*. The mitochondrial DNA evidence, with a probable 1 million years divergence, has not been calibrated against the closest relative, the Veery, in spite of my years of pleading. The conclusions are based on vocal, size, color, and DNA differences between the populations of northern and southern Québec and the Strait of Belle Isle (Québec and Labrador), where Dr. Ouellet did all his field work. Mostly June and July museum specimens were examined, from Québec, Maritimes, Newfoundland, and New England.

Ouellet (1993b:559) finds that the song of Bicknell's Thrush "does not fall to lower frequencies toward the end of the vocalization as in *minimus*; it remains constant or increases ([figure] 7). This difference can be detected in the field and provides an accurate means of identification." [Glaring exceptions occur, as in Fig. 1, bottom line.] The representative sonagrams (Ouellet 1993b:558, fig.7) were somehow mixed and the time scale is wrong, as each song should last nearly two and one-half seconds. Because Dr. Ouellet kindly provided me with a copy of his *bicknelli* tapes from southern Québec, and The Library of Natural Sounds did the same for Churchill, Manitoba, I have pinpointed the actual sources of all four songs in his figure 7 from sonagrams that I made and from viewing Dr. Ouellet's tape on a Uniscan II, the same kind of audiospectrogram machine that he used. Dr. Ouellet's sonagrams and my corresponding ones are shown with the background birds that prove my identifications are correct (Fig. 1). Dr. Ouellet's figure 7A (labeled *minimus* Schefferville) is the 15th song of *bicknelli* bird number one from Mégantic. It is identified by the two-syllable call "che-béc" of the Least Flycatcher, *Empidonax minimus* that follows closely after the thrush's last syllable. Dr. Ouellet's figure 7B (labeled *minimus* Churchill) is the 16th song of the same *bicknelli*, here identified by the greater lapse before the Least Flycatcher and by the prominent downturn of the last phrase, such that the song sounds like that of *minimus*. The next two songs are from a single individual at Churchill, obviously of the subspecies *aliciae*, from the low pitch of the finale (but labeled *bicknelli*). Dr. Ouellet's figure 7C (labeled Mégantic) is the fifth song of LNS 4203, which I designated score A+ because it has an extra grace note (the inverted V, third syllable from the end). It is identified by the Sora Rail's two calls as announced by Dr. Arthur A. Allen on the tape; they are the short curves of low pitch underneath the first and last notes of the thrush song. Dr. Ouellet's figure 7D (labeled Saint-Urbain) is the third song from the LNS tape number 4203 and it is from score A without the extra grace note; it is identified by the conspicuous song of the Northern Waterthrush (*Seiurus noveboracensis*) in the background. Stein (1956, plate 24:4b) shows the same score (A) performed as the eighth song of the same Churchill *minimus*.

Fig. 1 offers an opportunity to become aware of the differences among the sonagrams produced by the machines used by Dr. Ouellet: Multigon Uniscan II, linear scale and short time axis; Dr. Stein: Kay Elemetrics, linear scale, 2 1/2 seconds per page; and mine: Kay Elemetrics, logarithmic scale, otherwise the same as Stein's (Marshall 1977). Linear scale produces distortion that increases geometrically with ascent in pitch. The songs and calls are all contained within the frequency range of 2–8 kHz, which is two octaves represented approximately by the top octave of the piano and the next octave above. In the sonagrams of Ouellet and Stein, the intervals at the top of their figures have expanded to four times normal size as compared to the same intervals at the lowest pitches of the songs. Physicists, engineers, and musicians working with wave motion use logarithmic scale whether it be for light waves, ocean waves, radio waves, or sound waves because the phenomena studied recapitulate with each doubling of the frequency, called an octave. Yet ornithologists insist on the distorted linear scale. Teddy Roosevelt would call them nature fakers.

Ouellet (1993b) argues that Bicknell's Thrush differs from the Northern and Newfoundland Gray-cheeked Thrushes in a recently acquired habitat expansion. In Québec, timberline occupancy of the 1960s had changed to second-growth, lowland living by 1989 and 1990 (Ouellet 1993b, table 5). But table 5 does not fully support this downhill shift because the principal timberline habitat at 3600 feet altitude on Mont Jacques-Cartier was visited only in the early period of the study in 1967 (45 observations) and 1969 (four observations). There is no comparison of the 1989 and 1990 lowland observations with this mountain. Actually the Percé habitat along the road to the shrine of Sainte-Anne looks like excellent *bicknelli* habitat to me. The bird has been there all along, with or without logging, judging from summer specimens in the Canadian Museum of Nature (Appendix 1): one from 1914, four from 1915, and three from 1955.

In the course of looking for proven museum or field records of Bicknell's Thrush in his home state of North Carolina, David S. Lee (1995) provides an excellent summary of the nomenclatural summersaults the Gray-cheeked Thrush group has suffered. A graph shows spring and fall migration dates and frequency. Like George Wallace, Lee is pessimistic about field identification. From his own wide experience in the Greater Antilles, Lee (1995 p. 7) sounds the alarms for wintering forest-dwelling birds such as Bicknell's Thrush: "The two largest islands, Cuba and Hispaniola, obviously support the greatest areas of habitat for thrushes. The Haitian portion of Hispaniola, a country the size of Maryland, has been deforested for agriculture and for the charcoal industry. The border between the Dominican Republic and Haiti can be delineated by a line that is as visually well-marked as that between any field and forest [rocks to forest in the mountains right at the fence]. Extensive areas of agriculture also dominate much of the Dominican Republic. In that country these birds appear to be restricted to upland forest. Until the recent collapse of the Soviet Union and the loss of its economic ties with Cuba conservation and land ethics in Cuba were probably the best in the Caribbean. The current embargo enforced by the United States has cut off imported fuel, and has forced Cubans into developing massive charcoal works. This is devastating Cuban woodlands. On the smaller Caribbean islands most of the native hardwood vegetation was removed for lumber in previous centuries and many of the native winter fruiting hardwoods are in limited supply, or so young as to provide an insignificant and undependable food source for local wintering birds."

Parkes (1995), reporting on specimens in the Carnegie Museum of Natural History, makes a strong case for the recognition of grayish *aliciae* as a subspecies distinct from Newfoundland *minimus*, which is as brown-backed as *bicknelli*. What with overlap in winglength, this makes *minimus* and *bicknelli* practically indistinguishable. We are condemned to identify only the smaller *bicknelli* by size, but all of them have the yellow basal half of the mandible.

Botanical Papers

Four botanical papers important to us because they deal with little-known timberline and fog coast habitats of Bicknell's Thrush have appeared since 1939. In the last week of July 1954, J. S. Erskine visited Seal Island, Nova Scotia, and collected 190 species of higher plants of which 43 were introduced weeds

(Erskine 1955). "At present the higher lands, never more than fifty feet above sea-level and usually about twenty, are covered by a thick forest of white spruce with a limited admixture of black spruce and local intrusions of fir. Mountain-ash is frequent and sometimes occurs in pure stands where it is protected from the wind" (Erskine 1955:7). At a season when Olive-backed Thrushes would start molting and be silent, Erskine (1955:10) heard calls that most likely were Bicknell's Thrushes: "The land-birds are those of coniferous forest: browncapped chickadees, blackpoll warblers, myrtle warblers. There were thrushes to be seen which looked like olivebacks and yet sounded in their call-note, suspiciously different. They may have been Bicknell's thrush which used to be common on the island but which can be distinguished from the olive-backed only when singing." Erskine (1957:43) visited neighboring Mud Island in "mid-August" [when Bicknell's Thrush would be silent, out-of-sight, and undetectable] and found that "The woods behind the shore were like a miniature park of black spruce, white spruce and fir, for there was no underbrush, no young trees springing up to replace the old [because of sheep], scarcely any living thing below but frail enchanter's-nightshade and weedy chickweed and pale wood-sorrel. . . . The centre of the wood, however, was still intact, with taller knotty spruces and mountain-ash interspersed with long straggling shrubs of chokeberry and shadbush and withewood. . . ." (Erskine 1957:44). [The only conifer I could find there in 1992 is *Picea mariana*, identified by the clusters of old, persistent, spherical cones with scales of irregular margin.] Mud Island is listed as a breeding habitat of Bicknell's Thrush by Wallace (1939).

Vogelmann (1982) and Eckholm (1983) signal the demise of red spruce, *Picea rubens*, in the Green Mountains of Vermont owing to acid clouds from the west. [The effects are felt through the Appalachians from at least as far north as Whiteface, New York, southward to the Great Smoky Mountains of Tennessee.] These clouds brought by the west wind from the Ohio Valley had condensed on the red spruce and balsam fir needles. Having damaged the foliage, this water fell to the ground, killing the symbiotic mycorrhizal fungi attached to the root system. These are little black truffles one-eighth inch in diameter that process nutrients for the conifer. Soil samples preserved from beneath these trees in 1965 compared with those of 1984 identify the pollutants as dissolved acids and heavy metals (H. W. Vogelmann, personal communication). Dr. Vogelmann estimated in 1984 that the plant biomass, including undergrowth, had suffered a 40% reduction since 1975. [I concluded that the clouds, not the rain, damage the forest because the clouds settle against the west slope where the damage is, whereas the rain falls equally upon the east and west slopes of Camels Hump.]

Reports From the Field Prior to Loss of the Common Name

The following publications from 1939 to the present are by persons who encountered Bicknell's Thrush in the field and (except for Gabrielson 1952 and Stein 1956) knew it as a subspecies. On Mount Katahdin, Maine, Ralph S. Palmer (Palmer and Taber 1946) heard *bicknelli* singing on 16 June 1937 in krummholz of the Tableland. [Steve Oliveri (pers. comm.) did not find them there on 11 June 1992.] On other Maine summits farther west, Taber (1948:47)

found *bicknelli* “. . . to be present in numbers between Sugarloaf and Spalding May 31 and June 1, 1940. 6 recorded on the summit region of Bigelow on July 5, 1940.” Bent’s (1949) comparison of distribution and migrations of the two subspecies should have been the model of excellence for subsequent checklists. In the same volume of Bent’s *Life Histories*, Wallace (1949) summarizes his own book and sounds grave alarms about trying to identify *bicknelli* in the field.

Stanley C. Ball (1952) eloquently appeals to those of us who lie awake enjoying the migratory calls of thrushes as each species keeps in touch with its own kind while moving as a unit through the night sky. He tracks Bicknell’s Thrushes as they descend the valleys of the Gaspé (that radiate in all directions from the heights) preparatory to heading southwest. I have adopted Ball’s book as my inspirational bible of thrush migration, and have gone so far as to revisit sites of Ball’s fascinating observations, such as the town of Gaspé and Lazy Bogan. In reading Ball’s book, beware of his floundering among others’ syllabifications of thrush calls. When he deals with the evidence from his own ears, Ball’s observations are perfectly logical and reproducible: Most of the predawn migratory calls of September that I heard were uttered by flocks of Swainson’s Thrushes, whose whistle has a rising inflection. One or two out of a hundred calls will be a Bicknell’s high-pitched, descending shriek in my Gaspé experience. The Wood Thrush and Veery are not that far north, and the Hermit Thrush calls as it lands at dawn. But when Ball turns to other authors’ pitiful attempts at rendering thrush calls in written syllables, he gets the Hermit Thrush’s staccato “tup” all mixed up with the “chuck” of Bicknell’s Thrush. He knows that all such calls during migration turn out to be Hermit Thrushes on the ground, but he is unaware that the “chuck” of Bicknell’s Thrush, Newfoundland Gray-cheek, and Northern Gray-cheeked Thrushes is an optional introductory note to the song and is never used as a call either on the ground or in the sky.

Ball (1954:106) describes the breeding distribution of *bicknelli* on the Gaspé as “Not uncommon below timberline in the higher Shickshock Mountains. Also nests on Mount St. Alban [low elevation] behind Grande Grève and Cap-des-Rosiers where mists from the Gulf of St. Lawrence add moisture to the dense forest. Not yet discovered inland below 2500-foot elevation.”

In New York, Parkes (1954:162) “. . . found Bicknell’s Thrush to be common on the higher slopes of Whiteface Mountain, its preferred habitat being dense tangles of stunted spruce. . . . On Slide Mountain in the Catskills, type locality of the subspecies, I found Bicknell’s Thrush to be fairly common, but closely confined to the smaller spruce at the summit [now gone and replaced by balsam fir]. On Whiteface Mountain, on the other hand, this species extends down into forests of densely packed, towering spruce and balsam fir, where it overlaps the habitat of the Olive-backed Thrush.” [And it still does so today.] On his three fresh specimens, taken 5–6 June 1953 on Slide Mountain, Parkes notes the yellow base of the lower mandible and remarks that Bicknell’s Thrush has never been correctly represented in color [applicable as well to the present].

Here let me add Ira N. Gabrielson’s (1952) observations along the north shore of the Gulf of Saint Lawrence from 4 June–10 July 1947, even though he was unaware that he was travelling from Bicknell’s Thrush country right on east into the

home of the Northern Gray-cheek. This was a sad spring migration for our bird because the gulf was still in the grip of winter through the first week of June. Many migrant passerines died and Gabrielson was prevented from documenting what is so important to us today—whether or not a continuous population connected *bicknelli* at Little Mecatina River to *minimus* at La Tabatière, or indeed whether there was any substantial population at all west of Tabatière. “On June 4, Seven Islands was filled with snowbanks and the ground was snow-covered in the surrounding forest. Lakes were still frozen and wintry conditions prevailed. During the next few days Seven Islands, Mingan, and intervening villages were filled with birds. White-crowned sparrows, olive-backed and gray-cheeked thrushes, juncos, and white-throated sparrows predominated, but there were also many warblers, all having a hard time. In Seven Islands, remains of birds were everywhere, some killed perhaps by cats, others dying from starvation. On nearly every spot of bare ground, heads, feathers, and other fragments could be found” (Gabrielson 1952:45). As a result, few summering forest birds were heard or seen anywhere during the trip, and the only records of Gray-cheeks or Bicknell’s Thrushes were these (Gabrielson 1952:57) under the heading *Hylocichla minima aliciae*: “The gray-cheeked thrush was equally uncommon. There were numbers about Seven Islands when we arrived and several dead birds were found in the streets. There were also a number about Mingan June 7. The only individuals seen east of Mingan were one at La Tabatière on the 23rd, another at the same place July 2, and one in song at Rocky Bay June 26.” [Gabrielson’s Rocky Bay is evidently close to Spoon Cove on his map, where he mentions seeing other passerine species on 25 and 26 June. The birds in July and late June from Tabatière on northeast should have been *minimus*.]

Dilger (1956a) sometimes heard the Gray-cheeked Thrush and the Veery (*Catharus fuscescens*) respond to each others’ calls. [That would be in migration, because nobody had found sympatry on the nesting ground at that time. The mistaken response is due to unfamiliarity with the other species’ calls, as I explain in my section on calls in Discussion.] Dilger (1956b) finds the foraging stratum of Bicknell’s Thrush to be the most specific among the spotted thrush group. It forages solely upon the [shaded] ground.

Stein (1956) provides high-quality sonagrams for a comparison of songs among our five species of spotted thrush. He is dealing with species distinctions and therefore does not comment on the different inflection of the last phrase between *bicknelli* and *minimus*, whose songs he represents one right above the other. He is doubtless aware of the difference but regards it as too minor for his topic. This remarkable paper by Bob Stein, a landmark in bioacoustics, is so full of understated nuggets of truth that I shall devote a major part of my exposition of songs to discussing it (in Results).

Reports from the Field after Discontinuance of Subspecific Common Names

The following papers use the nomenclature of American Ornithologists’ Union (1957) in which the subspecies are gathered together under the one common name, Gray-cheeked Thrush. But we know from the breeding distribution that they are speaking of Bicknell’s Thrush as defined by Wallace (1939). Thus Godfrey

(1958:21): "The writer heard two calling on French Mountain [Cape Breton Island, Nova Scotia] on June 20 [1954] where Bond (MS.) noted the species on July 6, 1949." Robie W. Tufts, the younger brother (1961), spent a week on Seal Island, Nova Scotia, "... in June, 1922, and saw fair numbers, but it was not common. . . . On June 13, 1932, at Cape Forchu, a male was collected [Museum of Vertebrate Zoology, Appendix 1], and on July 13, 1935, several were heard singing on Bon Portage Island."

Kjos and Cochran (1970) radio-tagged 88 *Hylocichlas* of the four species other than the Wood Thrush during the migration period and show an activity record of a Gray-cheeked Thrush. "During the study the initiation of 25 migratory flights was observed. Thrushes began migratory flights after evenings of no movement, a few movements, and after short flights. So far, no *zugunruhe* nor any other activity pattern, diurnal or nocturnal, has been found to regularly precede migratory flight. There was nothing in the bird's behavior, even in the last seconds before take-off, to indicate that a migratory flight was about to take place (1970 p. 226). [I have vocal evidence that migration is about to take place for Swainson's Thrush, mentioned in my section on group migration in Discussion.]

Jehl and Smith (1970 p. 63) list the Gray-cheeked Thrush at Churchill, Manitoba, as an "Uncommon summer resident of the spruce woods. Most birds arrive in the first week of June." The accompanying photograph of the spruce woods looks like the endless spindly *Picea mariana* stand at Central, Alaska, in which Elsie Marshall and I found two Gray-cheeks countersinging at each other, but we considered it an unusual habitat for them in Alaska. Jehl and Smith (p. 9) mention that northward and toward Hudson Bay the forests open up, giving way to extensive sedge bogs and muskegs "and finally to the sedge meadows and lichen heath of the coastal lowlands, with their dwarf forests of willow and birch." [Apparently, the thrush at Churchill does not inhabit this willow and birch brush, which is its metropolis on the Alaska Range.]

Bull (1974) locates the southernmost breeding locality of the entire species at Peekamoose Mountain, Ulster County, New York. He shows typical habitat around John Burroughs' porcupine-chewed cabin on Slide Mountain (Bull 1974, figure 74).

In their tabulation of the most abundant species at the highest elevation of four montane transects, Able and Noon (1976) rank the Gray-cheeked Thrush as not among the four most abundant species on Mount Mansfield, second in abundance on Camels Hump, and fourth on two Adirondack Peaks (Whiteface and Nippletop).

The editor of Tufts (1986) cites [impossible] lowland summer records for Nova Scotia and states that Bicknell's Thrush had disappeared from Seal Island by 1938 except for one bird heard in mid-July 1983 by Ian A. McLaren. But Robie W. Tufts himself had admitted that his 19 May 1938 visit might have been too early in the season (Tufts 1961). [Indeed it was far too early, leaving us without hard evidence for survival of the population past 1922 (Tufts 1961) unless we accept, as I do, the perfectly reasonable surmise of Erskine (1955) that he heard Bicknell's Thrushes, not Olive-backs, on Seal Island in the last week of July 1954, as I noted above in the paragraph on botanical works.]

Arendt (1992), who has banded the bird in Puerto Rico (Appendix 1), tabulates winter occurrences of "*C. minimus*" as a casual winter resident on Haiti, Jamaica, Mona, and Puerto Rico. He regards it as only an uncommon winter resident in the Dominican Republic [where it actually is common].

Meanwhile in Québec, where Bicknell's Thrush is rare, comparatively quiet, and extremely difficult to detect, Ouellet's (1993b) persistence in June 1989 reaffirms its presence on the Gaspé and discloses three new mountain sites inland: Mont Mégantic 950–1080 m 45.28 N 71.09 W, Lac Elysée 980 m 47.44 N 70.41 W, and Mont Sir-Wilfred 750 m 46.41 N 75.36 W. He finds near Percé several small colonies nesting well below timberline in mixed stands of conifers and broad-leaved trees that regenerate following forest fires and clear cutting [which nevertheless are dominated by balsam fir and look perfectly normal for *bicknelli* to me].

Reports from the Field since Designation of Bicknell's Thrush as a Species

Evans (1994) uses digital audio technology to quantify and make objective the description of nocturnal migratory flight calls that Ball (1952) was condemned to render phonetically. One high-pitched call that Evans recorded from an overhead flight on the Atlantic coast of Florida matches a *bicknelli* ground call in the Library of Natural Sounds collection from Mt. Mansfield, whereas an overhead call from Minnesota finds its duplicate among ground calls of a Northern Gray-cheek from Churchill, Manitoba (LNS). After finding that most of the Florida calls are at higher pitch than most of those from Minnesota, Evans rightly concludes that the interior overhead migrants are *aliciae*, whereas the coastal Florida ones are *bicknelli*. [However, I am astonished at the disparity in pitch between the two taxa, which far exceeds that of my large sample of ground calls.] Thus Evans sets the stage for computerized, automated monitoring of nocturnal migration, which he is in fact carrying on at present (pers. comm.). Because Bill Evans kindly copied his Florida and Minnesota tapes for me, I analyzed them by my methods and am pleased to devote much of my discussion of calls (in section on Results, below) to his important work.

In three papers Christopher C. Rimmer and his colleagues report on an ambitious and highly successful campaign with volunteers and professionals to study Bicknell's Thrush in the field (Rimmer et al. 1993, 1996, and Atwood et al. 1996). Hundreds of mountaintops in New England and New York were climbed, censuses were carried out there and in the Dominican Republic, various census methods were tested and compared, and intensive banding and territory mapping has been done at Mt. Mansfield, Vermont. Spot-mapping of vocalizing males yielded breeding density estimates of 36–52 pairs/40 ha in 1992, 50–59 pairs/40 ha in 1993, 55–65 pairs/40 ha in 1994, and 45–53 pairs/40 ha in 1995. Wallace (1939) had estimated territory size at an acre or more. Mt. Mansfield is believed to support more than 250 pairs.

The crowning achievement of Chris Rimmer's (pers. comm.) project is the recovery of a bird caught and banded on Mt. Mansfield by Kent McFarland in the summer of 1995. McFarland himself caught the same bird again the following winter at our communal study area in the Sierra Batoruco, Dominican Republic.

CHRONOLOGY OF THE PRESENT STUDY

I studied the Northern Gray-checked Thrush on the campus of the University of Alaska at Fairbanks from 17–22 June 1968 during the American Ornithologists' Union meeting hosted by Brina Kessel. From 15–29 June 1980 I found nine small colonies of the thrush at isolated streamside willow thickets around Fairbanks, including Goldstream Bridge, but large numbers in willow and alder thickets in the open at Sithylenkat Lake, Eagle, and Bettles. At Wild Lake in the Brooks Range north of Bettles, 2000 feet altitude, I found no Gray-cheeks in the mature spruce forest.

After noting the great similarity between museum specimens of the Gray-checked Thrush and the Veery (especially the dark, heavily spotted Veerys of the West), Martha Hays Cooper and I set out for Newfoundland in June 1981, hoping to discover overlap of the two species and perhaps even hybrids. When we heard the calls of descending inflection and the songs, we were sure these taxa are closest relatives. On the way we visited rangers of the Green Mountain Club at The Octagon of Mount Mansfield, Vermont, Wallace's study area, where an incredibly dense and vociferous population of Bicknell's Thrushes was in full cry. In Newfoundland, we found a capricious, inconsistent habitat occupancy and spotty distribution of *Catharus minimus minimus*. Joined by Elsie Marshall I continued the search for an overlap zone through 22 August. Veerys were common throughout riparian vegetation of the southwest corner of the island and Port au Port Peninsula. On the Transcanada Highway 15 km northwest of Port-aux-Basques (12–13 July) was a north-facing slope where I could hear Veerys (riparian, below) and Gray-cheeks (krummholz, above) simultaneously. But 1.5 km to the east on the north-facing side of the valley below Table Mountain, I found substantial overlapping populations on 22–23 July. Elsie Marshall and I studied at this site "beneath Table Mountain" in August 1981, 31 May–13 June 1982, and 6 to 12 July 1983.

Meanwhile Vogelmann (1982) and Eckholm (1983) documented wholesale destruction of red spruce on Camels Hump in the Green Mountains of Vermont by acid clouds. Realizing that these botanical studies pertain to prime habitat belonging to Bicknell's Thrush and that the bird might become endangered, Roger B. Clapp and I first conferred with Dr. Hubert Vogelmann at the University of Vermont about the damage by acid clouds to the red spruce. Then we surveyed thrush populations in Vermont on the summits of Mansfield, Camels Hump, and Killington and on Greylock of Massachusetts. All this was in June 1984. We found Bicknell's Thrushes only in the intact forests of the leeward, east slopes. You could get sunburned walking among the dead and down conifers on the west slope of Camels Hump. I had conferred with George Wallace in 1983 and July 1984 and he had expressed concern for the loss of *bicknelli* habitat.

Beginning in 1981 with a succession of industry-oriented Republican administrations under Ronald Reagan and George Bush, it became clear that nothing would be done in the United States to ameliorate the air pollution threatening and already destroying high-altitude, Appalachian spruce forests and particularly the red spruce, *Picea rubens*. These are the principal home of Bicknell's Thrush

in the northeastern states and of other spotted thrushes all the way south to Great Smoky National Park. Therefore, in evaluating the prospects for survival of Bicknell's Thrush, it became necessary to inquire if any substantial population still nests in the comparative safety of Canada, where there is less air pollution (Gaspé, New Brunswick, Nova Scotia) and the white spruce and red spruce are intact. The only known major population was on Seal Island, Nova Scotia, now extinct due to feral cats. Bicknell's Thrush was abundant on that island around the turn of the twentieth century (Bent 1949), and a specimen attested to summer occurrence on adjacent Cape Forchu (Museum of Vertebrate Zoology number 103757, collected by R. W. Tufts on 13 June 1932—Appendix 1). My letters of inquiry, advising Canadian wildlife authorities and leaders of the Maritime Bird-Atlas Programme that they had in their area an endemic subspecies of thrush that might prove to be a distinct species produced only stunned responses from people who had never heard of such a thrush; and if there was one, subspecies were beyond the expertise of volunteers on the Atlas project. Seal Island, Nova Scotia's most important historic ornithological site, was not included among the randomly-selected census areas for the atlas. It is visited year-around by biologists but none had seen the thrush, as interest there was limited to study of marine mammals or to listing exotic migrants such as Chuck-wills-widow (*Caprimulgus carolinensis*) by the twitchers.

Elsie Marshall and I had already heard a dusk flight song of Bicknell's Thrush and answering calls from the ground at French Mountain, Cape Breton National Park, Nova Scotia, on 14 June 1982 during a return trip from Port-aux-Basques. Dr. Anthony Erskine kindly duplicated for me his catalogue of sightings and presumed nestings of Maritime Gray-cheeked Thrushes and David Christie pinpointed the colony he had discovered near the Nepisiguit River in New Brunswick. Thus fortified and armed with a permit generously provided by Environment Canada to capture, measure the wing, and release one or two birds from each province, Mrs. Marshall and I returned to French Mountain on 15–17 June 1988, made a census of the small colony, and caught a male that proved to be *bicknelli* (measured and released). From 25–27 June 1988 we did the same at David Christie's colony above the Nepisiguit, thus providing the first concrete evidence that *bicknelli* is the Maritime race, not Newfoundland *minimus* or an intergrade thereof. Elsie Marshall and I spent June 1989 in a futile effort to find the thrush on the North Shore of the Gulf of St. Lawrence, Québec.

In February 1990 in the Dominican Republic, Tomás Vargas of the Department of Natural Resources and I were in despair at our inability to detect Bicknell's Thrushes except from one or two spontaneous calls at dusk. Whereupon Tomás invented the method of soft playback through a headset, which was all we had. The weak signal from the Walkman unfailingly attracted the irate Bicknell's Thrushes from near *and far*. The same method did not work 4–14 March 1991 on Puerto Rico, which is therefore beyond the normal winter range. The gamut of remaining natural habitat on Puerto Rico was canvassed in the same places where loud play-back had failed to disclose *bicknelli* 11–21 March 1986.

Roger Applegate of the Maine Department of Natural Resources and I heard a Bicknell's Thrush's songs from the base of Mount Bigelow, Maine; it was prob-

ably a bird on a long-ranging nocturnal flight from the summit, early June 1991. The next midday we managed to call up several with tape play-back on Mount Washington, New Hampshire. The Mount Washington birds were in medium to tall forest, reminding me of the habitat selected by *minimus* in Newfoundland.

In June 1992 with the help of Jean Hoekwater and other state and provincial park authorities, Steve Oliveri, Capt. Hubert Hall, and Elsie Marshall (at one or the other locality) I studied Bicknell's Thrush at the Great Basin of Katahdin in Baxter State Park, Maine, and on Sagamook Peak in Carleton Provincial Park, New Brunswick. We could not locate the bird at Cape Forchu and Mud Island, Nova Scotia. In New York state in July 1992 Martha Hayes Cooper and I found abundant *bicknelli* at the type locality and remains of John Burroughs' cabin on the summit of Slide Mountain in the Catskills. Upon advice of Dr. Wesley Lanyon, I revisited his two territories at the top of Porter Mountain in the Adirondacks.

Through the courtesy of the Atmospheric Sciences Research Center's Whiteface Mountain Field Station, I heard in late July 1992 numerous Bicknell's Thrushes on Adirondack Whiteface. The view to the north revealed massive kill by acid clouds of conifers on windward, southwest-facing slopes from top to bottom. Richard McDonald (who assisted in listening for thrushes but had to desist when we were engulfed by a huge cloud that demanded his atmospheric chemistry expertise) told me that current explanation of the kill is not poisoning of the roots and associated mycorrhizal fungi but rather a dumping of nitrogenous nutrients from industrial pollutants that encourage too rapid growth by the root hairs so as to outstrip their capacity to thicken their cell walls enough to withstand eventual freezing in the fall.

From 28 August–7 September 1992 at Mount Mansfield, Vermont, Elsie Marshall and I enjoyed the spectacular resumption of calling and singing by *bicknelli* at the conclusion of the molt. The subspecies was common about Taft Lodge and west of the Octagon but was gone from the Wallaces' headquarters at Butler Lodge, now grown to tall forest.

With the kind assistance of Bertin Allard and his staff of Mount Carleton Provincial Park, New Brunswick, I studied Bicknell's Thrushes at the summit of Mount Carleton and Mount Head from 15–19 June 1993. From 23–26 June of that year I revisited the Green Mountain Club's Gorham Lodge on Camels Hump, Vermont, in hopes of finding the same songs being sung as prevailed in 1984. The birds were no longer in evidence around the lodge, however, although they were equally numerous as before about the summit.

In Costa Rica in April 1994 I witnessed the immense migration of Swainson's Thrushes in fig trees at the Golfito Airport, but I heard only one Gray-checked Thrush; it was at Monteverde Cloud Forest Reserve, 5000 feet altitude, and probably the same bird seen there the day before with painted bill and tail marked with a white chicken feather.

In June 1994 at Fairbanks, Alaska, I again recorded songs of the Northern Gray-checked Thrush at the Goldstream Bridge willows. Then Elsie Marshall and I found two singers in black spruce at Central. But we stumbled upon the main Alaskan population of this thrush along the eastern half of the Denali Highway in the Alaska Range. The population seemed infinite. It filled whole landscapes

of dwarf birch, *Betula glandulosa*, and willow brush below tundra but above timberline in altitude.

At Port-aux-Basques area, Newfoundland, I could locate only one Newfoundland Gray-cheeked Thrush from 6–10 September 1994 and thought that either their migration or their molt was in progress. On the Gaspésie (Gaspé Peninsula) from 13–14 September 1994 I heard Bicknell's Thrushes at Mont Jacques-Cartier and in westward migration overhead (Ball 1952) at Mont Saint-Pierre, a village on the central north shore of the peninsula. Then with the help of Tiz Williamson and precise directions from Dr. Henri Ouellet I witnessed the resumption of singing by families still on their territories above Percé, on the Gaspé Peninsula, through 19 September 1994. On 21 September family after family sounded off in the balsam firs at sunrise, around the 3500 foot level in the Great Basin of Katahdin, Baxter State Park, Maine.

En route to Siberia in July 1995 I heard two Gray-cheeks in willows at Nome Airport, Alaska. Thanks to a slide show and briefing by Chris Conroy of the Mammal Department, University of Alaska Museum, I was able to pinpoint the only willow thicket (*Salix alaxensis*) in the Provideniya area, Magadan Province, with its many Northern Gray-cheeked Thrushes singing in the dawn-dusk midnight on 6 July 1995. The enormous population along Denali Highway, Alaska, was revisited by Mrs. Marshall and me 8–10 July 1995, when we heard huge outpourings of communal song by Gray-cheeks at midnight in the endless "chaparral" of dwarf birch. Susan Jewett and I visited Mt. Carleton in September 1995 but found no thrushes at all on account of drought. We heard a few calls of *bicknelli* at Percé on the Gaspé Peninsula.

During migration in September 1994, May 1995, September 1995, and May 1996 (with Greg Scheib) I attempted to tape-record overhead migrant thrushes at various places such as coastal Maine, Hudson River (at Tallman Mountain State Park), Delaware River, and foothills of the Blue Ridge in Virginia, but I heard no sounds of *Catharus minimus* amongst all the *Catharus ustulatus*.

2

METHODS

MUSEUMS

I examined the venerable museum specimens that constituted Wallace's only reliable evidence for distribution and status of Bicknell's Thrush (Wallace 1939, his appendix). I noted the color (of fall specimens—whether olive-gray, olive-brown, or brown, and how much redder is the tail than the back) and measured the wing of most of the same specimens and had the same results as Wallace's. Mine is not a morphometric study, for this was already successfully achieved by Wallace (1939). The measurements I took at museums and those taken by colleagues at museums I did not visit are simply to verify Wallace's data and to identify the few specimens not seen by Wallace. The wing measurement in millimeters is a chord across the curve of the unflattened, folded wing from wrist to tip of longest (eighth) primary feather. If well under 96 mm this measurement is the only certain means of identifying Bicknell's Thrush. This point cannot be overemphasized, especially when one compares Ouellet's (1993) optimism with Wallace's (1949) sobering alarums about the difficulty of identifying Bicknell's Thrush in the field. When measuring the wing chord you must determine first if the secondary flight feathers are restored to their natural deployment along the full length of the ulna, as shown in Color Plate 1. In some collections, such as that of Louisiana State University, Baton Rouge, the secondaries of all thrush specimens have been stripped down the ulna and left there. They press against the primaries, straightening them and making the chord measurement longer than normal. Such lazy, ill-advised skinning technique is an assault upon the utility of ornithology's most valuable, consistent, and widely-used means of estimating body size, namely, the chord of the dried, folded wing.

FIELD

I entered locations of individual Bicknell's Thrushes directly on maps after hearing the song or call, or with luck, after actually seeing them. Official topographic maps of Environment Canada and the United States Geological Survey that were used give altitudes in feet and distances in kilometers (always with one-kilometer grids). The only exception was the map for Mount Washington, a National Park in New Hampshire; it was entirely metric. But conspicuous along the road leading to the summit were signs giving each thousand-foot interval, to keep you from going absolutely crazy. I bowed to the inevitable and long ago gave up trying to think of altitudes in meters or converting the contours and map figures from feet. All the maps that illustrate this report are on kilometer grids with

altitudes and contours in feet. I paced off distances among Bicknell's Thrush territories in meters, using 75 paces (right plus left) for 100 meters. My observations written in the field, including those spoken to me by my field companions, are in the field notebook archive in the library of the Division of Birds, Smithsonian Institution, Washington, D.C.

Field, Hand-Held

Officials of the various Departments of Natural Resources in Newfoundland, Québec, New Brunswick, Nova Scotia, Maine, and Dominican Republic allowed me to net birds and measure the wing to determine the subspecies prior to immediate release on the spot. The result was one bird each for Nova Scotia, New Brunswick, and the Dominican Republic, which leaves Maine still without a verifiable record of an actual, small, measured, breeding Bicknell's Thrush.

Field, Summer

I back-packed to the timberline habitat of Bicknell's Thrush at one or two mountains in each state or province in the known breeding range. Four sites were reached by car: TV Road, New Brunswick; Mount Washington, New Hampshire; Mount Mansfield, Vermont; and Whiteface, New York. Roger Clapp and I ascended Killington Peak, Vermont, by ski lift. I searched for Bicknell's Thrush in historic sites of nesting. I located additional summer colonies by listening for the calls or songs at dawn and dusk. At other hours my standard technique was to walk along through likely habitat and utter a loud imitation of the call—a two-toned combination of whistle and voice with falling inflection. I soon came to realize that response by the Hermit Thrush or Veery due to confusion with their own descending calls meant no Bicknell's Thrushes in the area and that these two species had no opportunity to learn the *minimus* call in that particular place. If my whistle produced no answer I would play the songs and calls on a tape recorder. During the late summer cessation of vocalizing a tape-recording played faintly through tiny ear-phones would bring *bicknelli* into view if I was hidden at a distance to watch the head-set before which the bird would posture. This also worked in the breeding season at midday in those parks where the roads or trails are closed at the dawn-dusk singing periods (Mount Washington open 8:00–6:00 and Mont Jacques-Cartier open 10–4).

Field in September Following the Molt but before Migration

I searched for the species at Butler Lodge (Green Mountain Club 1991), where apparently Martha Wallace found the nests (Wallace 1979). At Mt. Mansfield I listened for the flight songs and resumption of singing that Wallace had discovered. At Percé and Katahdin I discovered family vocalizing, where four or five birds call or rattle or practice singing from a small area, presumably the nesting territory. Were it possible to get around an entire colony during each dawn period in late September, one could easily count the entire population from the calls of both

adults on their territory, the practice songs and calls of their offspring, and the concerted rattling of each whole family.

Field, Spring and Fall Migration

I have listened to the night sky through stereo microphones in an effort to carry on the beautiful work of Ball (1952) on nocturnal migration. I am just beginning this pursuit, and so far can account for thousands of Olive-backed Thrushes, a few Hermit Thrushes, but only two Bicknell's Thrushes, which apparently move later than the others, perhaps beginning only in October. Based on the wealth of migrant specimens of both *minimus* and *bicknelli* from Fort Lee, New Jersey, in the Smithsonian Collection, the Hudson River should be a major path for the conjoined migrants of Bicknell's and Newfoundland Gray-cheeked Thrushes. But I have heard none there, at Tallman Mountain State Park in several May and September attempts, made with the kind permission of the New York Park Authority.

Field, Winter

I visited Hispaniola in order to show that the subspecies, *bicknelli*, really winters there in numbers. Detecting the wintering bird in the Dominican Republic required an entirely different approach from summer. I first learned that winter-territorial birds are either frightened by, put off by, or uninterested in the loud, aggressive songs and calls of summer during a frustrating search for Black-capped Vireos (*Vireo a. atricapillus*) in Nayarit during February 1988. A vireo might answer the tape once, or skulk forward for one look; then it would disappear, not to be called up again the same day. It was impossible either to focus the binoculars or to identify the age and sex or even to tell if it might be the hen-feathered subspecies, Nelson's Vireo (*V. a. nelsoni*). Worse, in the Caribbean wintering area of Bicknell's Thrush my ear-splitting whistles and songs blasted out on speakers (Sony TCD-5M, Marantz-Superscope) yielded no response whatsoever. This was so discouraging that I brought no speaker to the Dominican Republic, where Tomás Vargas and I hoped merely to net the subspecies by chance. After several disappointing days, Tomás suggested a last try at the net, where we played the summer songs and calls softly on the Sony "Professional" Walkman's tiny headset (MDR-50). Within seconds we had a Bicknell's Thrush in the net and a second glaring about for the supposed intruder with faint voice. In this way I also called up two territorial owners close enough to be identified at the Botanic Garden in downtown Santo Domingo. (Voices from Camels Hump, Newfoundland, and Fairbanks were equally efficacious in our experience.) The same method used on a return trip to Puerto Rico disclosed absolutely no hidden, secretive population there but the method worked at midday in the summer breeding area during July, when the birds are mostly silent. Eugene S. Morton (pers. comm.) suggests that songs from a loud tape recorder ricochet among the leaves to indicate distance, and that birds' ears are exquisitely tuned to such nuances that are imperceptible to humans. According to Dr. Morton, it is the faint, direct voice from nearby that ignites an immediate defense of the winter territory—for which we coined the term "hyperbellicose whispers."

AUDIO

In order for you to see Bicknell's Thrush in the nonsinging seasons of winter and late summer, it is absolutely necessary to hang the small, speakerless tape recorder at a good, horizontal perch in a tree, there to play the calls or songs faintly through a small headset. Leave a minute or two of blank tape before the first call in order to allow yourself time to hide far out of the way and then to focus your binoculars upon the expected perch. Tomás Vargas and I hide at least 40 m from the tape player—a distance where we cannot hear the calls ourselves. From nowhere the Bicknell's Thrush appears at the planned perch and assumes for a couple of seconds a posture with head, body, and tail in line tilted down in front and with the bill pointing directly at the tiny, Walkman earphones a few inches away. Then the bird vanishes into the direction from whence it came.

I recorded in stereo with two Sennheiser ME-80 microphones mounted 35 cm apart on a crossbar to my pointed hiking stick, thrust in the ground. Because the Sony Walkman WM-D7 and digital TCD-D7 that I use are consumer products they lack a balanced microphone input. On a professional tape recorder, on the other hand, the three-pronged XLR plug (Cannon plug) connects to the microphone by way of separate prongs numbers two and three, leaving number one for the shield. For the Walkman, with only two connections, the microphone cables made in Japan have wires one and two both combined with the shield inside the XLR and number three is the hot wire. Then number three acts as an antenna, picking up extraneous electrical disturbances and nearby radio stations. Therefore, in working on mountains with radio broadcast towers such as Mount Mansfield, Vermont, and Conche, Newfoundland, you must rewire the inside of the XLR to connect one and three to the shield and leave number two the hot wire from the microphone. I thank Michael A. Wascher for clearing up for me this radio menace. Another lesson I learned to my cost is that Dolby noise reduction cuts out remote songs of Gray-cheeked Thrushes. However, I was able to confirm a locality record of the species in central Newfoundland (one-half mile south of Lloyd's Brook) by listening to the Dolby-recorded cassette with Dolby turned off. This was of particular interest because it is the only simultaneous recording of the Hermit Thrush (*Catharus guttatus*), Olive-backed Thrush, and Gray-cheeked Thrush that I have from Newfoundland. Dolby likewise masks the steam hiss of Hermit Thrushes, Veerys, and American Robins (*Turdus migratorius*) as well as the song of the Blackpoll Warbler (*Dendroica striata*) in the equipment I use. These tones are between 9000 and 10000 Hz. Belatedly I find I must follow the advice of J. W. Hardy (pers. comm.) not to use noise reduction in the field. Dr. Hardy has always advocated the use of relatively inexpensive consumer audio products, as opposed to the elegant and very expensive professional variety. I agree fully and believe that it is the proximity of the microphones to the bird and the removal of one's person from near the microphone that make for a good recording rather than the price of the equipment. Consumer digital audio tape equipment is, however, loaded with extraneous copy protection programs, so it might be worth it to save your pennies and buy the simpler, more elegant professional machine that costs in the thousands of dollars.

The use of stereo is absolutely necessary for assigning family members or neighboring males to their corresponding songs when they are duetting or engaging in song rivalries. In Elsie Marshall's and my work with gibbons (Marshall and Marshall 1976, Marshall and Sugardjito 1986), stereo recording permitted each voice in a family duet or trio to be linked to the male, the female, or the daughter. Although a disappointment for fixing roles to male Gray-checked Thrushes in choruses because they moved about constantly and traded places as they sang inside the timberline thicket, stereo was a great help for making sonagrams from these choruses or from rival males because I could choose whichever track had the loudest song. Because all modern-day tape recorders come with the stereo capability, I am amazed that ornithologists still prefer to have their machines "neutered" to mono. For those who feel that the two shotgun microphones in tandem that I use are cumbersome in the field, there are available directional stereo microphones as a single hand-held unit that are of the highest professional quality.

I rarely use tape-recorded play-back because my own voiced whistle is adequate for calling up *Catharus minimus* on the nesting area and because the small Sony Walkman recorders I use lack speakers. But I find in winter, when my whistle does not work, and in special circumstances when the song must be broadcast, that the headset is perfectly useful even though barely audible to human ears.

By spring of 1996 I had recorded in the field 8 hours, 23 minutes, 45 seconds of *Catharus minimus* from Siberia, Alaska, Newfoundland, Québec, the Maritimes, New England, and Dominican Republic. In 1968 I used the Nagra III tape recorder and Beyer directional microphone for 1 minute, 50 seconds of songs at the University of Alaska campus. From 1980–1992 I used the stereo Sony TCD–5M (and occasionally the similar Superscope-Marantz) and later the Sony WM–D6, without a speaker and good for back-packing; two Sennheiser ME–80 directional microphones were used, mounted on the hiking staff. The small, stereo Sony microphone ECM–909 was handier for long hikes. In that period I recorded 5 hours, 43 minutes, 40 seconds of songs and calls of the species. From 1993 to 1995 I depended upon the very small Sony stereo digital audio tape recorder TCD–D7 with the same Sennheiser and Sony microphones in order to record 2 hours, 38 minutes, 15 seconds of *Catharus minimus* sounds. By populations, my recordings are for the Northern Gray-cheeked Thrush (Alaska and Siberia) 3 hours, 8 minutes, 45 seconds; for the Newfoundland Gray-cheek 1 hour, 34 minutes, 45 seconds; for Bicknell's Thrush in summer and fall 3 hours, 33 minutes, 15 seconds; and for Bicknell's Thrush in winter, 7.00 minutes. In addition, I have recorded in fall of 1994 and 1995 1 hour, 59 minutes, 35 seconds of predawn nocturnal migrants over the Hudson River, New York; Port-aux-Basques, Newfoundland; and the Gaspé Peninsula, Québec. There are only nine descending whistles among the hundreds of Olive-backed Thrush migratory calls in these overhead tapes and only two or three of the nine are certainly *C. minimus*.

I tape recorded Gray-cheeked and Bicknell's Thrushes as concrete evidence of occurrence and for identification of individual singers. I did not harass the birds with playback. Analysis of the vocalizations follows the method of Marshall (1977) and Marshall and Sugardjito (1986). I enter the song or call of the thrush

from the stereo tape player into the Kay Elemetrics Digital Sona-Graph 7800 from the loudest channel (left or right) at the 8 KHz frequency range and normal dynamic range. Then I print the sonagram on the Kay Elemetrics model 7900 printer that yields resolution of 400 lines vertical, 1000 lines horizontal, and 23 levels of gray scale on a stable type of thermofax paper. Sona-Graph and Sonagrams are trade names for the Kay Elemetrics Corporation sound spectrograph and the spectrograms produced. The common substitution of the tradename, sonagram, for the generic form results from widespread use of earlier model Sona-Graphs.

The Kay Elemetrics Digital Sona-Graph 7800 is to my knowledge the last machine to provide the option of logarithmic scale. No computer program of audio analysis is logarithmic. Yet all wave motion behaves logarithmically, and this is evident in the traditional musical staff (Fig. 2) that keeps equal intervals on the vertical scale for each octave, which is double the frequency of the preceding octave. I use the logarithmic scale and broad analysis filter of 300 Hz. One copy is made with a reference line at each kHz from 2 to 8 applied by the printer. It turns out that all songs on my sonagrams have the highest notes of part II (Ouellet 1993) just touching the 8 kHz line (8000 cycles per second) and the lowest notes of the Alaska birds' part IV descend to 2 kHz. That, I believe, suffices for the reader to compare songs and appreciate their similarities in pitch. (Notice however that *bicknelli* makes a narrower trace, declining not much lower than 3 kHz.) Therefore I dispense with kHz guidelines for songs on the duplicate sonagrams made for figures and tables in this book, so as to achieve greater clarity for the notes. But in order to show the true musical intervals I superimpose or indicate the C clef centered on c^5 , 4186 Hz, note 88 of the pianoforte, which is the median pitch for all these songs. A measure, representing one second, is 123 mm on the original sonagraph.

Because I have been critical of colleagues' audio mixups (Marshall et al. 1991, p. 314; this book, Introduction), I should divulge my own elaborate scheme to identify and label what is on my tapes. With a timer I listen to the cassette or tape reel and mark down the songs, calls, announcements, and background noises on lined note paper with each horizontal space representing one minute, which is divided into six 10-second intervals across the page. The start of a song or sonagram is identified to the minute and second on a cassette of a particular kind and number *and this is written on the sonagram as soon as it is made*. I underline with red pencil on the tape workup sheet each call or song for which a sonagram is printed. My field cassettes are at the Bioacoustic Archive, Florida Museum of Natural History, University of Florida.

3

RESULTS

OBSERVATIONS OF NORTHERN GRAY-CHEEKED THRUSHES, FROM WEST TO EAST

Russia: Siberia (Map 1)

Provideniya, Magadan Province, Near Sea Level

With the help of tour director Yvonne Dazé Lizenkova and nature watercolorist Vladimir Zhikhartsev I was able to tape-record on 6 July 1995 between 23:00 and 23:45 hours the spontaneous singing of Gray-cheeked Thrushes in a continuous, chest-high to head-high thicket of an inconspicuous, gray, fuzzy willow identified as *Salix alaxensis*, felt-leaf willow, by Dr. David Murray of the Botany Department, University of Alaska Museum. This was just above sea-level at the head of the Provideniya Fjord on an alluvium from a broad river valley of wet tundra strewn with the loveliest flowers imaginable, but whose bright colors barely pierced the gloom. The willows are confined to rock and gravel alluvium undercut about 1 m by the rivulets and therefore left high and dry. They are the only plants more than a foot high in the entire Provideniya area. The thicket, wide enough in places for two territories, extended several kilometers as far as the eye could see up the valley, to the north, to where it was lost to view in a bend of the valley. All the songs I recorded were from one male, the closest, in full view at the top of a willow. I heard several others to either side of him. Among the calls, sour notes like the Veery were frequent. Providence, who saved Captain Thomas Moore and his ship over the winter of 1848–49, again stepped in and insured that I had to wait until after working hours of the captain and his one-man crew to make the long boat trip northward up the fjord, thus arriving at the willow thicket at the one darkest time of night whose gloom incites crepuscular Gray-cheeked Thrushes to call and to sing. To the birds, it is both dawn and dusk—a double reason to sing. I would never have found them at another hour. No other birds sang spontaneously on this trip except the Snow Buntings (*Plectrophenax nivalis*) in town.

Alaska (Map 1)

Nome Airport, Sea Level

At Bering Air parking lot, Nome Airport, Alaska, at 11:00 hours of overcast 3 July 1995 I directed my whistled imitation of the piercing Gray-cheeked Thrush call towards the nearby willow thicket across the river. A Gray-cheek immediately answered with three faint songs from a patch of tiny willows on the grassy knoll about 50 m seaward of the main, continuous willow thicket. He uttered sour notes and then typical clear calls that I recorded. Later, what seemed to be a second

male on the next territory inland, responded with a few faint songs and then calls from the dense, continuous belt of willows and about 200 m from the first bird.

Sithylemenkat Lake, 620 Feet Altitude and Bettles Map 1

At midday on 27 June 1980 I found numerous Northern Gray-cheeked Thrushes in willow and alder thickets in the open at Sithylemenkat Lake (Round Lake). These thickets were west of the outlet stream and inland from the lake margin with its rampart of low cottonwoods, aspens, and paper birches. I recorded the chorus of alarm notes by three or four presumably nesting birds protesting some unseen intrusion. These Northern Gray-cheeked Thrushes from the thicket also went into scraggly birches, aspens, and spruce to call. Others sang whisper songs as they moved along low, apparently on the ground. Vegetation around the lake appears to be at or above tree line, but it is actually in a rain shadow from mountains to the southwest and its few white spruce trees, growing along the outlet stream at the north edge of the lake, are stunted and widely spaced. I taped the three-song repertoire of a male who sang faintly from tall willows beside a pond. This male duplicated almost note-for-note three of the four songs of a male I recorded at Ace Lake, University of Alaska, Fairbanks, 223 km to the southeast and 12 years earlier. The two birds must belong to the same lineage that was divided during the migration back from South America.

At Bettles, 27–28 June 1980, Gray-cheeks were common in alders and willow thickets around the airport and around grass-filled ponds. They also spilled over into deciduous woods (dwarfish birch-aspen-cottonwood) mixed with short spruce forest, which they shared with Swainson's Thrushes. The short stature of this forest minimizes their habitat differences. At Wild Lake in the Brooks Range north of Bettles, 1100 feet altitude (Map 1), I found no Gray-cheeks in the mature spruce forest with alder understory.

University of Alaska, Fairbanks

From 17–22 June 1968 the Gray-cheeks sang in spruce forest with cushiony ground cover of lichens and moss at Ace Lake, Smith Lake, and back of Moore Hall, our dormitory. In the twilight of early morning one emerged from deciduous woods along a campus street west of the dorm and hopped along the sidewalk, foraging just like a crepuscular Hermit Thrush. I recorded the songs of two individuals, one back of the dorm on the 19th and another in dwarf spruces at Ace Lake on the 21st. The campus bird of 19 June is example 1 on "Voices of the New World Thrushes" by Bill Hardy and Ted Parker III (1992). Three of the four song scores of the Ace Lake bird were fairly accurately repeated by the male I recorded at Sithylemenkat Lake 12 years later and 223 km distant. On 20 June 1980 I revisited the west campus by Smith Lake but heard Gray-cheeks only along a willow-lined ditch by the railroad track. Unfortunately I did not attempt to locate the two other territories of 1968 because at that time I did not know that the songs are like fingerprints, individually unique, although this had been discovered by Stein (1956).

Fairbanks

From 15–29 June 1980 I found nine small colonies of the thrush at isolated streamside willow thickets in the open around Fairbanks. Four willow areas with

Gray-cheeks on the northeast side of Fairbanks are just patches because the streams there are not continuous. I visited a territory on Chena Hot Springs Road at its junction with Bennett Road on 15, 19, 25, and 29 June and each time I could find only one male, whose songs I taped. This minimalistic enclave of one territory is to be compared with the well-documented two territories of Bicknell's Thrush on the top of Porter Mountain, New York. The other birds I taped are in two choruses, one at Old Steese Highway, the other in an extensive thicket of short willows and alders on the south side of Richardson Highway at Moose Creek. I am unable to match these songs into individual repertoires of three or four song-types—a common complaint where I have several singers moving about and changing places on the stereo microphones. The Moose Creek habitat must have been man-made, as uniform regrowth perhaps from woodcutting or a plowed field. It was monotonous, extensive, and dense with closely-spaced, vertical stems of willows and alders over a sparse cover of moss, lichens, and dead leaves. This was the home of Fox Sparrows (*Passerella iliaca*) and Gray-cheeked Thrushes. However, on the north side of the highway was a luxuriant and varied habitat of tall willows and alders, waist-high grass, and sloughs with marsh grasses where many species of birds held forth, including abundant Swainson's Thrushes (*Catharus ustulatus*) but no Gray-cheeks.

In June 1994 I returned to Fairbanks but forgot my maps and so failed to locate any of the 1980 territories except Goldstream and Moose Creek. At Moose Creek I found no Gray-cheeked Thrushes, nor did I find any along Pile Driver Slough, Eilson Farm Road, and Old Richardson Highway. The habitat of 1980 on the south side of the highway at Moose Creek had grown taller and I heard two Swainson's Thrushes countersinging in there as well as a Hermit Thrush (*Catharus guttatus*) in the background. Virtual elimination of Swainson's Thrush in unchanged habitats around Fairbanks was noted with grave alarm.

Goldstream Bridge on Ballaine Road, Fairbanks

On 20, 21, and 23 June 1980 I mapped at least seven singing male Northern Gray-cheeked Thrushes in willows and alders and the black spruce bog nearby to the northwest of the bridge. I tape-recorded about four birds, hard to keep track of because they were so close together. Several territories were actually shared with Swainson's Thrushes and both species used the same song perches at different times. Songs of the male number 1 on the north side of the bridge and west bank of the stream reflected between the bridge and a ditch, making all double sonagrams from the echo. In parts of that tape the same songs can be heard in the distance, from what I had already recorded close by as male number 2, whose songs are free of the echo. I assume therefore that males 1 and 2 are different individuals but probably nest mates. Number 2 also sang from the black spruce bog, thereby conflicting with number 3. On 21 June I taped the weird buzzing noises of number 3 as he chased another thrush round and round inside the spruce at waist to shoulder height above the ground cover of heath and lichens. I have never again heard such calls, even in a similar situation at Mt. Carleton, when two chasing Bicknell's Thrushes sang run-on songs instead.

In June 1994 I returned to the Goldstream Bridge in hopes of tracing song traditions since 1980 but I found only certain familiar phrases within songs that were

composed anew. The three males that I recorded were spaced about the same as those of 1980, but this time they were on the southwest side of the bridge. All the big willows were dead and a lot of alders and birches were evident among the smaller willows that remained. To sing, the males sat very still near the top of a spruce or highest stem of dead willow, sang a long time, and then dove to the ground. Some performances were introduced by a long series of calls.

In the early morning of 13 July 1995, Gray-cheeks were not singing a dusk/dawn chorus, but I whistled up individuals on about four territories. Meanwhile at least four Swainson's Thrushes sang spontaneously, a most welcome sound considering that in 1994 they had all but disappeared from the Fairbanks area (Brina Kessel pers. comm.). Dead alders and dead willows protruded from the rank woods and green marshy growth—home to Lincoln's Sparrows (*Melospiza lincolni*). These deciduous woods around the bridge may be getting too tall for Gray-cheeked Thrushes.

Maclaren River at Denali Highway, Mile 42, 2932 Feet Altitude; Photo 1

On 21 June 1994 Mrs. Marshall and I were headed westward along the Denali Highway hoping to find Gray-cheeked Thrushes in spruce forests near Denali National Park. But bad weather forced us to stop for the night at mile 42, Maclaren Lodge, 2932 feet altitude on the west bank of the Maclaren River. At 04:00 the next morning I heard a Gray-cheek on the other side of the river, so I crossed the bridge that supports the largest Cliff Swallow (*Hirundo pyrrhonota*) colony in the state (Brina Kessel pers. comm.) and I recorded songs of the thrush as he sang from the highest available perches. These were dead trees 2–2.5 m tall that protruded above the general level of the willow or birch brush at about chest height with ground cover of moss, lichens, and blueberries. Other thrushes west of the bridge darted across the road, always at about 18 inches above ground, which is half the height of the prevailing brush. One of these birds was watched foraging along the fairly open side of a bank, where it could be seen to hop a few steps, then draw itself erect, in the foraging manner of the Hermit Thrush. The number of these thrushes crossing the road convinced us that we had at last stumbled upon the metropolis of Alicia Kennicott's Gray-cheeked Thrush population in endless brush of dwarf birch and willows mixed with blueberry. The waist-high to chest-high thicket resembles California or Mediterranean chaparral except that it is pale green instead of olive-drab. It fills whole landscapes well above timberline but below tundra. Conspicuous perching birds within it are the Northern Gray-cheeked Thrush (*Catharus minimus aliciae*), Arctic Warbler (*Phylloscopus borealis*), Wilson's Warbler (*Wilsonia pusilla*), Tree Sparrow (*Spizella arborea*), and Gambel's Sparrow (*Zonotrichia leucophrys gambeli*). If this brush is responsible for the major flourishing of *Catharus minimus aliciae*, then I assume that together the bushes and the bird sweep across Alaska and for 960 kilometers on into Siberia. The song repertoire of another male was recorded in a tall, slender willow at Tangle Lake Lodge, mile 22, as were others at about miles 20 and 9 farther east toward Paxson on 22–23 June.

Near latitude 65°N—about that of Provideniya, Nome, and Fairbanks—and 63°N for the Denali Highway, midnight is not really dark in June or July and there are no flight songs of Gray-cheeked Thrushes such as take place under cover of darkness in the breeding range of the Newfoundland Gray-cheek and Bicknell's Thrush. The gloom of dusk/dawn extends for an hour or two on either side of

midnight; apparently this intensity of light is what sets off an enormous outpouring of communal song from the Gray-cheeked Thrushes in July and therefore past the season of territorial announcement. Thus Elsie Marshall and I were surprised to hear thrushes at midnight as far as our microphones could pick up the rich sounds during our revisit from 8–10 July 1995 to Maclaren Lodge. This is within the huge vista of continuous, waist-high birch and willow brush in fairly level or gently-contoured countryside beneath the Maclaren Glacier. Dwarf birch, *Betula glandulosa*, is the principal bush, growing in pure stands that extend as far as the eye can see. Its little leaf is scalloped and about 12 mm in diameter. In some places the birch is mixed with willows, which predominate east of the Maclaren Bridge. In Gray-cheeked Thrush territories I collected, in addition to the birch, *Salix alaxensis*, *S. barclayi*, *S. glauca* group, *S. planifolia*, *Spiraea steveni*, and *Vaccinium uliginosum*. As with the Provideniya feltleaf willow, these plants were identified by David Murray and are deposited at the University of Arizona Herbarium with all my other plants connected with studies of endangered bird species, including those of Bicknell's Thrush habitat in New Brunswick.

Dr. David Murray (pers. comm.) assures me that whole vistas of a similar dwarf birch, *Betula nana exilis*, with willows clothe large areas of northeastern Siberia, as at the head of the Kolyma River. However, Dementiev et al. (1954:547) mention only "high osier beds" as the Siberian habitat. Thus I assume that similar brushlands supporting two-hectare territories of Gray-cheeked Thrushes in endless two-dimensional array in both Siberia and the Alaska Range can account for populations of stupendous numbers that I could not have imagined from my previous experience with little enclaves of Gray-cheeked Thrushes in krummholz, taiga, and willows at stream junctions and of Bicknell's Thrushes at timberline.

I tape recorded a particularly tame singer that sang from the top of a dead willow at the junction of Denali Highway with Maclaren River Road. I also recorded other individuals and choruses and made plant collection to the east of the bridge where a mixture of willows predominates over the birch.

Central; Map 1

Leaving Central at 10:30 hours on 15 June 1994, Mrs. Marshall and I stopped while heading south at mile 122 to see what if anything might occupy the flat, monotonous scene of crowded, short black spruce growing over a deep cushion of Labrador tea, moss, and lichens. Two Gray-cheeked Thrushes were counter-singing, one on each side of the highway. We taped and photographed them (only a little dot at the top of a spruce) until they stopped singing when the sun came out of the clouds.

Eagle; Map 1

I arrived at Eagle, on the west bank of the Yukon, a little after 08:00 hours on 18 June 1980, when Gray-cheeked Thrushes would have stopped singing. I hiked through deciduous forest of cottonwood (*Populus balsamifera*), aspen, and birch and through spruce forest and dwarf spruces with understory of heath and lichens without finding any thrushes. I did not reach open meadows and marshes with willow and alder thickets until late afternoon, while we waited for a relief plane (ours having been wrecked at another airport). I heard from all sides the

“view” or “bew” descending call of *Catharus minimus*. I did not know this call at the time and I confused it with a similar, one-syllable, descending, explosive call of the many Alder Flycatchers (*Empidonax alnorum*) that were conspicuously visible and audible on tops of the willows and were also uttering their “fee-bee-oh” or “feebee.” I did not actually see a Gray-cheeked Thrush, but I assume they were common beneath these willows.

Manitoba, Canada

Churchill

I did not visit Churchill, but I refer to it here because of the superb recordings made of a male Northern Gray-cheeked Thrush there by Peter Paul Kellogg and Arthur A. Allen beside Landing Lake Road on 15–16 June 1954. The recordings are filed in the Library of Natural Sounds, Cornell University, as LNS number 4203 for 15 June with 14 songs and 4204 for 16 June with nine close songs. The entire holding of the species (19 minutes, 35 seconds) was copied through the courtesy of Andrea Priori of the Library first for Dr. Ouellet and later for me, when I sought to trace and identify published sonagrams of Bicknell’s and Gray-cheeked Thrushes, with results detailed in comments upon Dr. Henri Ouellet’s contributions in the Introduction to this book. Sonagrams of all the 23 Churchill songs showed that the bird has three song-types and that every jot and tittle—that is each of the hundreds of individual notes—is performed exactly the same on successive days.

On 27 June 1996, Sandra L. L. Gaunt recorded three Gray-cheeks at Churchill and sent me those with a fourth male recorded by Scott Shackleton 20 km east of Churchill on 12 June 1989. These are copies from the Borror Laboratory of Bioacoustics, numbers 17992 and 21279–21282. Our purpose was to ascertain if some of the same songs of 1954 were being used in 1989 and 1996 at Churchill. One C-type short song is almost the same.

Costa Rica

Monteverde Cloud Forest Reserve, 1530 m altitude

On 11 April 1994, between 06:00 and 07:00 hours, a *Catharus minimus* called its piercing *bzew* notes for a half minute back of the garages across from Headquarters. Later it called twice more inside the nearby dense rain forest. [The previous afternoon I had seen possibly the same bird foraging in foliage (like *swainsoni*) and on the driveway at Headquarters. It was grayish and had a white chicken feather glued to the tail. I could not see its face, nor could I find out who had marked it.]

OBSERVATIONS OF NEWFOUNDLAND GRAY-CHEEKED THRUSHES, FROM WEST TO EAST AND NORTH TO SOUTH

Quebec, Canada

La Tabatière

Arthur A. Allen photographed in color a Gray-cheeked Thrush on its nest at La Tabatière, apparently in June 1947 (Allen 1951:41). Dr. Henri Ouellet declared it a Gray-cheek, not a Bicknell’s Thrush (in litt.). Allen and Peter Paul

Kellogg recorded on tape two males for the Library of Natural Sounds, Cornell University. The recordings were made on 16 June 1953 for the male on LNS number 4206; sonagrams of its three faint songs are unclear. I made 23 sonagrams of songs from the close male of 17 June 1953, LNS number 4207. Dr. Ouellet and I agree that these songs are characteristic of the Northern and Newfoundland Gray-cheeked Thrushes and that they do not ascend in pitch at the end in the manner of Bicknell's Thrush. They represent an apparently numerous population extending from La Tabatière northeastward along the North Shore all the way to Cape Charles, Labrador. Therefore Gillet (1935) was wrong to identify the birds he heard at La Tabatière as *bicknelli* and Todd's (1963) "St. Lawrence Thrush" is a composite of *bicknelli* and *minimus*.

La Tabatière is only 60 km farther northeast along the coast from the Mouth of the Little Mecatina River, Québec, which is the farthest north and east specimen of Bicknell's Thrush. There could have been a gap, overlap, narrow hybrid zone, or zone of intergradation between *minimus* and *bicknelli* within that space, where now the population (if there ever was one) is extinct.

Newfoundland, Canada; Map 2.

The actual finding of overlap between the Veery and the Newfoundland Gray-cheeked Thrush in 1981 seems such a hard-won victory, so fraught with ecologic and behavioral importance, that I do not hesitate to set down the events as they happened, literally transcribed from my field notes. Mercifully, I shall leave out the parts where I cut trails and walked the railroad to the mouth of Bear Cove Brook in order to approach supposed Gray-cheeked Thrushes, whose distant, descending "bew" calls turned out to be alarm notes uttered by a male Redwing (*Agelaius phoeniceus*, "bzeee"), a nesting pair of Northern Harrier (*Circus cyaneus*, "see"), and Tree Swallows (*Iridoprocne bicolor*, "dzeet").

Martha Hays Cooper and I in June 1981 found a capricious, inconsistent habitat occupancy and spotty distribution of *Catharus minimus minimus* throughout western Newfoundland. We never found the species outside of dense spruce and fir regardless of height and texture of the stands. We were searching for the alleged broad zone of overlap with the Veery, embracing all of southwestern Newfoundland according to Dilger (1956b). Joined by Elsie Marshall I continued the search through 22 August. Veerys were common throughout riparian, broad-leaved vegetation of the southwest corner of the island and Port-au-Port Peninsula. Grey-cheeked Thrushes seemed to be entirely absent from the southwest, until I happened to hear them as noted below in the paragraphs on Table Mountain, Red Rocks, and South Twin Hill. Table Mountain was the sole locality of overlap with the Veery.

Conche; Map 2

I found on 25–26 June two Gray-cheeks in conifers on a steep slope above the town dump outside of Conche and four more near the crest of highway 434, four miles out of Conche. These last represented a thin population in continuous, short spruce-fir forest at the edges of a flat, open, summit area of tundra, tarns, and rocks.

Three Mile Rock; Map 2

A new coastal highway north of Gros Morne National Park cut the luxuriant seaside krummholz in two, leaving not enough width for Gray-cheeked Thrush territories along the western strand. However, at Three Mile Rock, the highway ducked inland to avoid a little ravine, leaving space for numerous thrushes. I camped in the ravine from 9–11 August 1981 and found only fully-grown, silent, independent juveniles of both Swainson's and Gray-cheeked Thrushes. They produced purple droppings from the plentiful gooseberries they ate. Aside from an outburst of calls by at least two Gray-cheeks in the fir forest at 21:00 hours of 10 August, I found no evidence for the presence of adults, even with nets.

Blue Ponds Provincial Park; Map 2

On 30 June and 4–5 July 1981 I heard Gray-cheeked Thrushes sing and call briefly in tangled growth of spruce and fir at the west border of the pond. Swainson's Thrushes were more numerous throughout the logged-off park, but were equally reluctant to sing and call this late in the season.

Boswarlos; Map 2

At the west edge of this village on the Port-au-Port Peninsula, a Gray-cheeked Thrush called "bew" from a dooryard of a house at the edge of town and then sang from an alder thicket in the adjacent meadow on 27 June 1981. It was not there on 3 July 1981. I think it was a wandering individual, but that is strange for a time when it should be on a nesting territory. From 23 June–19 August 1981 I spent 17 days searching for thrushes all over Port-au-Port Peninsula and neighboring areas near Stephenville, including Romaines River, Carter's Road, St. George's, and Barachois Pond Provincial Park. I turned up no other Gray-cheek but found innumerable Swainson's Thrushes in spruce-fir forest, innumerable Veerys in broad-leaves, and Hermit Thrushes on five territories in flat places with scattered spruce or tamarack trees over blueberries. When I played tape-recorded songs of *minimus* at an alder thicket along the mouth of Romaines River, a Veery responded—a sure sign that Veerys there are unaccustomed to real Gray-cheeked Thrushes.

Fir Forest 30 km East of the Start of the Burgeo Road; Map 2

This tall forest on the north slope of a mountain had not been logged nor infested with budworms. I arrived there on 5 July 1981 in time to hear the last singing of Swainson's Thrushes during late dusk (before 21:45 hours) and the onset of calling and singing during flights or chases by three or more Newfoundland Gray-cheeks at around 22:00 hours.

Northwest Base of Annieopsquotch Mountains (1/2 Mile South of Lloyds Brook), 83 km North of Burgeo; Map 2

Gray-cheeks were heard here at the edges of a barren, tundralike area while three Hermit Thrushes sang on territories in open boggy coniferous woods with a few birches. Three or more Swainson's Thrushes sang sporadically from denser firs in the same place, so that their territories apparently overlapped those of the Hermits. That was on 9 July 1981. I had not heard Gray-cheeks there on 6 July and on 16 August I heard only Swainson's calling.

Burnt Pond Brook, 62 km North of Burgeo; Map 2

This was the southern extent of tall fir forest and its abundant Swainson's Thrushes along the Burgeo Road. In the afternoon rain of 8 July 1981 I heard four or five Swainson's Thrushes call and sing as well as one Gray-cheek calling. Gray-cheeked Thrushes would have to share the same forest with Swainson's here because there was no other habitat except unsuitable meadow and rocky streambed.

Grandys (Glannys) Brook, 45 km North of Burgeo; Map 2

When I stopped on 8 July 1981 to cook breakfast in this roadside, dwarfish spruce-fir forest with some big *Larix* and deep moss everywhere, Gray-cheeked Thrushes were tame and easily watched. One foraged along the sandy creek bed, taking series of two or three long hops ending in an upright posture on long legs, making it seem very tall—more extreme in this posture than a Hermit Thrush. One darted across the highway and into the forest at high speed. It veered, suddenly banking as they always seem to do, clearly showing a white wing bar for the entire length of the underwing, like *Zoothera* (and *Ixoreus* if you think it different). On this southern portion of the Burgeo Road, the forest patches, hemmed in by granite barrens of tundra and ponds, are too small for the other *Catharus* thrushes.

Burgeo; Map 2

Newfoundland Gray-cheeks were the only thrushes at this town, which provided my only examples of stationary birds in alder thickets, on 7 July 1981. I heard the "bew" call from alder brush at the motel in early morning. Then I found several of them calling and singing for brief periods in the fog. At least two sang in dense, short coniferous forest of a north slope beside a cove, and another called and sang in an alder thicket with Wilson's (*Wilsonia pusilla*) and Yellow Warblers (*Dendroica aestiva*), where I would have expected Veerys. By dusk I had cut a trail through the spruce-fir forest of the cove in order to record the singers at close quarters. But by 22:00 hours, when rain commenced, only one bird obliged and he had gone to the opposite side of the cove. This was my first introduction to the species' habit of changing the stage on successive evenings for its group concerts in July.

Table Mountain; Photo 2, Map 2

During World War II an Armed Forces road was built up the canyon north of Billys Pond to Table Mountain, where a radar antenna was installed. During midafternoon after a storm on 15 July 1981 I hiked up this road for about 1.4 km to where it crosses the brook. Along the way I heard about four Veerys and seven Swainson's Thrushes in the varied riparian tree-growth of birch, alder, *Prunus*, and *Sorbus* alongside spruces and balsam firs of the slopes. This thicket became progressively shorter with ascent of the road, from four to five meters below the 500-foot contour to three to four meters nearing the coniferous timberline with its krummholz and talus slides. (The broadleaves continue upward along rivulets.) At the 500-foot contour, about 300 m short of the bridge over the brook, Veerys and Swainson's Thrushes left off and Gray-cheeked Thrushes began. There I got good looks in the binoculars at one *ustulatus*, two *fuscescens*, and two *minimus*, one of which sang from the top of a dead spruce and when he was through, dove straight down with closed wings.

From 22 July–5 August I camped at this site west of the bridge and had five nets up from 31 July–5 August under firs in center foreground of Photo 2 where the slope beneath the canopy was clear, permitting an unobstructed but covered swoop downslope to drink at the brook. (Merlins, *Falco columbarius*, regularly patrolled this area.) Apparently I had expected to catch a hybrid, but I should have watched in concealment for territorial behavior instead of netting. Birds caught and released were three adult and two juvenile *minimus*, one adult and one juvenile *fuscescens*, and six adult and one immature (well along in post-juvenal molt) *ustulatus*. These birds had purple droppings from eating berries. All three species went into net number 1; both *minimus* and *fuscescens* entered nets 2 and 4. In this period there was no longer the separation observed on 15 July, for the three species roamed, called, and sang from all around my camp at the 500-foot contour. There were some spectacular late evening songfests of *minimus*, not at the same place on successive nights. On 22 July they sang at my camp, 23 July high on southeast slope in krummholz at the base of a talus slide, 24 July in a huge chorus extending from the NW side krummholz around me to the east and southeast, on the 25th across the canyon to the northwest, and on 26 July from a krummholz area several hundred meters to the southwest of camp, where Veerys sang earlier and Swainson's Thrushes later than the Gray-cheeks. That was the last evening of concerted singing by any of the thrush species, and the last singing of the Veery. A few songs or partial songs of Swainson's Thrush were heard up through 3 August. During the same period I was also aware of marked degradation in the quality of *minimus* songs, which after experience with families of Bicknell's Thrushes at Percé, I now attribute to practice by the juveniles. For example, my notes for the huge chorus of 24 July say that the "dzeet DZEET dzeet of many birds introduce their respective wildly improvised songs"; on 29 July full songs and snatches of songs in the morning and at 21:30 hours calls and various parts of songs for five minutes; on 31 July "all three species of *Catharus* called near camp; *ustulatus* and *minimus* uttered a few partial songs"; 1 August "an excited *C. minimus* called at dusk, his wild, highest-pitched 'dzeooo' often leading right into an unmusical song—this is the prolonged, two-part, falling call"; and 2 August "lot of calling dawn, morning, dusk, and during the day from *ustulatus* and *minimus*, not much heard from Veerys; some singing of squealy, unmusical songs by both species. The next morning was the last date for songs of both species anywhere in my subsequent travels of 1981.

Elsie Marshall and I revisited the camp the evening of 22 August 1981 and heard calls of all three species, showing that at least the young were still there. We felt that our efforts had failed to reveal any ecologic or behavioral evidence of spatial separation of the *Catharus* species beneath Table Mountain because we began the observations after fledging of the young—all the birds seemed to be released from territorial restrictions. We resolved to return the following spring in order to observe exactly how territories were set up and maintained against the congeners.

Accordingly we arrived early in 1982 in a vain effort from 31 May–13 June to witness interspecies conflict in setting up territories. All we saw were fights over food between Veerys and Swainson's Thrushes. There was so much snow on 31 May that these silent thrushes spent all their time hopping along and pulling

worms from the grass that showed where sunlight thawed the Armed Forces Road. With their feathers all fluffed out, the interscapulars humped up, head drawn in, and wingtips held together they looked like bouncing balls. A group of four birds on 5 June (three Veerys, one Swainson's) resented being thus thrown together. When two Veerys got too close together, one inclined its bill upward and stretched out its neck a little—sufficient to restore proper distance. The first Veery followed the path of the Swainson's in what seemed to be unproductive foraging until it turned out he was aggressive toward the Swainson's, with whom he finally caught up and chased to the edge of the road. There they fought, snapping their bills as they simultaneously popped up vertically .5 m several times in front of each other like popcorn. The Swainson's Thrush lost this one.

During these first few days there had been no singing but lots of rattles and other calls by both species, which had arrived in abundance, although no migratory calls were heard at night. The sounds around camp included the higher pitched Veery calls that to me were confusingly like some calls of the Gray-cheek, but yielding no real evidence for the arrival of any *C. minimus*. The first songs were those of a dawn Veery chorus all along the valley on 5 June. Late afternoon (20:50 hours) of that day, a swift chase through camp was accompanied by a full song in flight by *Catharus minimus*, followed later by two calling sessions far uphill at the uppermost firs. Again from uphill, at 22:15 hours a few calls were followed by three stately, leisurely songs in strict form and then at 22:23 hours about five unhurried songs high in a flight pursued northward over the canyon and circling west. Desultory calling around camp by all three species on 6 June was noticed; the *minimus* was confined to the uphill site, whence three of his songs issued (if not in flight) from 22:25–22:30 hours. The morning of 7 June welcomed the first songs of Swainson's Thrushes after a very brief Veery chorus; there was no sound from *minimus*. But in the evening, new Gray-cheeks were evident from voices of at least two around camp, a couple of songs up the slope to the east, and another bird across the brook (to the north).

From 8–13 June 1982 the thrushes gradually developed more concerted singing, but only by dawn of 13 June did I find a Gray-cheeked Thrush actually singing steadily, loud, and stationary in the firs just above my camp. Most of the Gray-cheeks' musical contribution was in the form of their spectacular, high, long-ranging song flights after dark. I have heard these performances, extolled by Wallace (1939) for Bicknell's Thrush, only in the Newfoundland and New England populations of the species. It never gets dark in Alaska during the Gray-cheek's tenure there and the birds do not make this display, although I have seen and heard them sing several songs on a flight from one song perch to another. (I have also witnessed such song flights at mid-tree level for the Veery and Bicknell's Thrush.) At my camp below Table Mountain, the *minimus* song-flights usually were launched from high on the southeast slope above me and the birds travelled horizontally out over the valley, made a big circuit, and returned, during the course of six or more songs. These songs were often either curtailed or otherwise atypical and run-on. One singer passed out of hearing down the canyon and returned five minutes later. All this was surmised in the darkness merely from the sounds to cupped ears or by monitoring the stereo microphones.

As for the objectives of the trip, the birds presently settled down to their summer routines and we saw no territorial conflict whatsoever and thought the three species—which paid no attention to each other—might well have overlapping territories. But we could never see any of their activities, even from our pup tent, except when they sang from treetops; even intraspecies territoriality in Newfoundland is a closed book to us. I was able to ascertain the reality of only one territory each for an Olive-backed Thrush and a Veery, through their eventual steady singing from regular perches just west of the pup tent. Ecologic conclusions that might be justified from the foregoing shambled observations seemed to be merely that the three species of thrush were brought together for the summer's residence on territories at the 500-foot contour because of their separate vegetation preferences and that once there, they mixed around each other as do the plants. Veerys had ascended riparian growth along the uppermost dendrites of the brook that penetrate coniferous timberline owned by a colony of perhaps 25 pairs of Gray-cheeked Thrushes; the Olive-backed Thrushes were attracted to the taller groves of conifers just below. The glaring fact that strengthens our belief that some inexorable ecologic law is being enforced, albeit sloppily, is simply that there are no Veerys or Olive-backed Thrushes above this study site, and no more Gray-cheeks above or much below the coniferous krummholz in spite of the continuation upward of substantial, dense, broad-leaved brush. Veerys (riparian) and Olive-backs (fir forest) continue down slope to the sea in large populations interrupted mainly only by the Trans-Canada Highway at kilometer 15. The Newfoundland Gray-cheeked Thrushes, on the other hand, are narrowly dispersed, doubtless no more than one territory wide, in a horseshoe, both prongs of which extend on opposite sides of the canyon as far southwest as songs can be heard in the microphones. On 8 June I wrote in my notes: "I am beginning to think the territories and nestings are *a fait accompli* and that singing has some other function, since it hasn't started much yet for *Catharus*. If you have to wait until they sing to find the territorial boundary and if they are going to wait until they sing before they find a mate, the nesting season will have an awfully late start. Further, how can the *minus* song flight mark a territory? [From position of start and finish? In the dark? With no dive at the end as done by the lark?] Is its area predictable?"

In 1983 Elsie Marshall and I again camped at the same spot from 6–12 July. At this time, thrushes sang individually long and loud from well-established perches, enabling a rather forlorn attempt at mapping territories. This was not the desultory singing of June nor the nonterritorial, group songfests of late July. My sketch map of song perches, if not of actual territories, showed the perplexing mixup of species; much of this is due, I believe, to the need of each singer to get as high as he can. That is what brings both the riparian Veery and the krummholz Gray-cheek to the top of the tallest available spruce in or beside their territories.

The upshot of the three summers' observations of 1981, 1982, and 1983 at the valley beneath Table Mountain is that the Veery does not hybridize with its closest relative, the Gray-cheeked Thrush. These species and the Olive-backed Thrush never have the slightest difficulty in distinguishing their respective songs and calls even though to the human ear, or at least to my ear, the lower Gray-

cheeked Thrush calls sound much like the higher Veery calls that are actually an octave below. As in a similar study (Marshall 1960) with Brown Towhees (*Pipilo fuscus*) and Abert's Towhees (*Pipilo aberti*) the two close relatives, of identical feeding habits, paid absolutely no attention to each other notwithstanding their overlapping territories—well worked out by color banding 300 towhees over the years in a study site not much larger than that on Table Mountain. As with the towhees, baiting the thrushes with berries in order to read their bands would be extremely difficult and would yield the same results as so strongly suggested by the three summers' work: each species of thrush pursues its daily round of activity oblivious to the other two species and acts as if they did not even exist.

I could locate only one Newfoundland Gray-cheeked Thrush at this site from 6–10 September 1994. It uttered two calls there at 14:20 hours of 7 September. I thought that either their migration or their molt was in progress. But migration seemed unlikely at that early date, and indeed no Gray-cheek voices were heard in the predawn outcry of hundreds of warblers, sparrows, and Swainson's Thrushes above the Port-aux-Basques Motel on 10 September 1994. [These were migrants evidently looking for a landfall in order to avert heading across part of the Atlantic Ocean at sunrise.]

Red Rocks; Map 2

On 13 July 1981 I camped at a colony of Gray-cheeked Thrushes in a luxuriant krummholz fronting the ocean at Red Rocks, at the end of an unpaved road running north to the railroad quarry. From the ocean inland were first rocks, then a vertical bluff topped by grasses, then the railroad, then the dirt road, then rich tundralike vegetation of flowers, sedges, grasses, and ericaceous shrubs with *Juniperus communis*, followed by the Gray-cheeked Thrushes' home in a dense thicket or mat of depressed balsam firs and spruces. This latter was narrow, for within a few meters inland the trees were high enough to walk beneath and this was the home of an incredibly dense and vocal population of Swainson's Thrushes that carried on to halfway up the slope, where the conifers became stunted at the approach of timberline near the 600 foot summit, capped with a communications tower. (I spent an hour up there on 16 July 1981 without finding any Gray-cheeks, even though the timberline growth duplicated that of the shore down below that harbored them.) The farthest south Gray-cheeked Thrushes were within hearing distance of the Veerys 350 m farther inland in alders along Bear Cove Brook.

At late dusk (just before 22:00 hours) of 14 July 1981 Gray-cheeks sang all along the 700 m of this narrow krummholz from the quarry to the start of the road to the TV tower. They had not performed during the preceding storm. I tape-recorded them on the evening of 15 July 1981. By 20–22 August 1981 I could find no trace of the Gray-cheeks either by imitating their calls or by netting. Swainson's Thrushes had also left this area. Local people said the thrushes had all gone to the inland side of the hill, where abundant partridge berries were available. But there were plenty of other kinds of berries at the Red Rocks site. The absence of any calls, even of Swainson's Thrushes, seems conclusive, and this is the more remarkable since calls of all three species were still to be heard at my camp below Table Mountain.

I found no thrushes in this same strip of ideal habitat on 31 May 1982. But by the evening of 9 June 1982 two Gray-cheeked Thrushes called and sang there. They continued at long intervals from before sunset until 22:30 hours with short songs and no song flights. After dark, a Swainson's Thrush whistled and rattled as if getting ready to migrate.

"South Twin Hill"

At sunset of 12 July 1981 I heard from the Trans-Canada Highway 15 km northwest of Port-aux-Basques plenty of both Gray-cheeked Thrushes and Veerys calling simultaneously. This was at the north base of what I am calling "South Twin Hill"—the hill on the south bank of Billys Pond, a few meters east of the start of Road 408, where a sign marks "15 km to Port-aux-Basques." The Veerys were in alders nourished by the standing water of a roadside canal (dug into the hill beneath a roadcut for a previous route); they called and sang until early dusk. The Gray-cheeked Thrushes were higher up the north slope, in firs of the krummholz; they called occasionally while the Veerys sang but performed their main chorus after the Veerys were silent, at late dusk. There were song flights too, apparently, but it was too dark for them to be seen. At 05:00 of 13 July 1981 it was already too late for songs, but I recorded simultaneous calls of Veerys and Gray-cheeks. On the early, sunny morning of 17 July 1981 I heard a Veery call and sing in the alders and a Gray-cheek call up above in the timberline krummholz. I could find no overlap between the two species. Just round the hill to the west, the brook descending with Road 408 to Cape Ray supported natural riparian broadleaved trees with Veerys fronting equally abundant Swainson's Thrushes in spruce-fir forest up-hill on Sugar Loaf ("North Twin Hill").

OBSERVATIONS OF BICKNELL'S THRUSH, *CATHARUS MINIMUS BICKNELLI* FROM NORTH TO SOUTH, Map 4

Negative results [locality in brackets] all pertain to historic sites (Wallace 1939).

Quebec: [North Shore], [Magdalen], Gaspé.

North Shore, Sea Level to 2200 feet; Map 3

From 4–21 June 1989, Elsie Marshall and I searched white spruce and balsam fir forests along the north shore of the Gulf of Saint Lawrence from Forestville to the end of the highway at Havre Saint Pierre and around Chevery (reached by airplane). We whistled and played tape recordings throughout the vicinities of Forestville from 4–5 June, Sept-Iles on 5–7 and 10–12 June, Manitou Falls on 7 June, Havre Saint Pierre from 7–10 June, Reserve Faunistique de Sept-Iles—Port-Cartier on 13–14 June from the coast to 120 km inland at 2200 feet altitude (and forested summits of 2250 feet in view with no timberline), and Chevery and mouth of the Little Mecatina River from 16–21 June. We found no Bicknell's Thrushes whatsoever. The forest is principally white spruce and balsam fir somewhat thinned by cutting for fuel. Unfortunately we reached only one of the four documented localities of the thrush (Appendix 1), the mouth of the Little

Mecatina River. I flew over Romain and Point Natashquan, but could only start toward the head of Grand Portage (1837 feet altitude), as the road to a dam being built there was still under construction.

On mountains that support large populations of Bicknell's Thrush in timberline coniferous thickets, that bird also occupies taller conifers at somewhat lower elevations. We saw plenty of the latter configurations along the North Shore—indeed every variety of coniferous growth except what was needed, a real low thicket. We could never find a mountain of suitable altitude to support an actual timberline, such as is desired by the thrush. Unless such a habitat can be found, it appears that our search for, and proof of, intergradation between Bicknell's Thrush and the Newfoundland Gray-cheek is doomed. We are astonished that four specimens could have been taken there from 1915–1928. Dr. Henri Ouellet (pers. comm.) in 1961 travelled the entire North Shore from west to northeast and encountered neither subspecies of *Catharus minimus* until he reached the Strait of Belle Isle, where the Newfoundland Gray-cheek held sway on the Québec and Labrador side.

Magdalen Islands, Québec, Near Sea Level; Map 3

Douglas McNair (pers. comm.) spent May–October 1992 on the Magdalen Islands, finding no Bicknell's Thrushes in the formerly occupied conifer stands, particularly on Cap-aux Mueles (Grindstone).

Mont Jacques-Cartier, 4189 Feet and Village of Mont Saint-Pierre, Near Sea Level

At timberline of *Picea alba* and *Alnus* at 3600 feet altitude just north of the summit of Mont Jacques-Cartier, where the trail crosses Ruisseau Galène, at noon of 13 September 1994 I heard the concerted rattling call of a family of Bicknell's Thrushes, which at the time I thought was a Ruby-crowned Kinglet (*Regulus calendula*) that I squeaked into view. The rattle, rougher than that of the kinglet, was linked to the thrush later at Percé and Katahdin. Bicknell's Thrush is known in summer near this spot, from collections by Dr. Henri Ouellet (Appendix 1). I was unable to hear dawn and dusk calling of *bicknelli* because the trail was open only from 10:00 A.M. to 4:00 P.M. But from the great mass of mountain projecting above timberline, I can guess there are many miles of proper timberline habitat making this the home of the largest population of *bicknelli* in Canada.

From the coast north of the summit of Jacques-Cartier, before dawn of 14 September 1994, I recorded two migrating *Catharus minimus* in the sky among hundreds of *Catharus ustulatus*. I stood in the bottom of the glaciated valley, 4.3 km south of the north coastal village of Mont Saint-Pierre while the birds flew coastwise and westward, following the rules laid down by Ball (1952). They were high above me and above the level of the steep sides of this valley. Sonagrams of the two calls, filtered and amplified, are described in the Calls section at the end of these Results. Ball (1952) finds only local Bicknell's Thrushes passing thus westward along the north coast of the Gaspé. As far as the Newfoundland Gray-cheeked Thrushes are concerned, there are none on Anacostia Island (that would have to hop across to the Gaspé); Newfoundland birds must go via Nova

Scotia; and Ball (1952) has never heard any Gray-cheeks approach the north shore of the Gaspé from the Gulf of St. Lawrence, which means that birds from northern Québec continue up the St. Lawrence River to reach the Mississippi flyway. Thus, by elimination, the birds I recorded in flight would have to be local Gaspé *bicknelli*.

Mont Sainte-Anne, 1000 Feet, Percé, Gaspésie, Québec

At Percé, Dr. Henri Ouellet kindly directed Tiz Williamson and me to his study area on the coastal slope of Mont Sainte-Anne just west of the Cathedral, along Route du Mont Sainte-Anne, beginning where that route branches off and ascends to the south from Ave. de l'Église. In the first 300 m there, at around 300 feet altitude, from 17–19 September 1994 we heard dusk and dawn “bew” calls from entire families of *bicknelli* on four territories. Between 05:10 and 05:45 h on the fine, clear day of 18 September I listened in utmost astonishment (and taped in digital stereo) to two family vocal exercises, each a pandemonium. These consisted of various normal descending calls from far and near but also wrongly-inflected calls like the juvenile food call. The second family's practice session included experimental songs among which was one that sounded like an Olive-backed Thrush. The proper, diagnostic, rising last note of *bicknelli* was finally achieved at least once. This all sounded like 1) a roll-call of each family, 2) loud territorial calls of adults, 3) loud practice of calls and songs by the young, just finding out how powerful is their voice, and 4) prolonged concerted rattle calls and normal single rattles (corresponding to the “tidaddy” of *Catharus ustulatus*). The concerted, group rattle sounds like a family of Wren-tits, *Chamaea fasciata*, going to bed in California chaparral and it enabled a retrospective identification of the earlier noonday rattling at Mont Jacques-Cartier. I conclude that these Bicknell's Thrushes have finished molting, have resumed full voice as Wallace (1939) noted in the first week of September, have remained on their family territories, and have not yet migrated. Susan Jewett and I visited this colony in September of the drought year, 1995, and heard only a few calls of *bicknelli*.

New Brunswick

Summits of Mount Carleton Provincial Park, 2550–2690 Feet Altitude

I ascended the north trail of Sagamook Mountain (2550 feet), Mount Carleton Provincial Park, during a rainstorm on 25 June 1992 and near nightfall stepped out of the forest at 2250 feet altitude and onto the boulder-strewn summit dominated by small, low red spruces, large mountain ash in full bloom, scattered balsams, and rich, alpine, ericaceous shrubbery and turf with Labrador tea and the lichen, *Cladina alpestris*. Here a couple of calls played on the tape recorder brought an immediate response from a Bicknell's Thrush, the first I have ever found in Canada in the predicted, correct habitat at proper altitude. Sagamook is one of four summits of 2550 feet altitude or higher, joined together at the 2300 foot contour, the southwest of which is Mount Carleton, at 2690 feet the highest point in the Maritimes. If only the summits above 2500 feet support proper vegetation for the thrush, then its area is about 75 ha. If on the other hand the winds and boulders decree that alpine plants and red spruce dominate the

level areas between the four summits, then *bicknelli* habitat could amount to five or six square kilometers. In either event, it is a question whether Mont Jacques-Cartier in Québec or Mount Carleton is the largest remaining Canadian enclave of Bicknell's Thrush.

After staying from 15–19 June 1993 near the summit of Mount Carleton I conclude it has a far lesser population of *bicknelli* than does Jacques-Cartier because I heard only one bird (at 2450 feet) within the tall coniferous forest that intervenes between Mount Carleton and Mount Head (2600 feet). In proper, depressed habitat of red spruce, balsam fir, and birch I found eight territorial males around the summit of Carleton from 2450 feet at the southeast base on up. However, a disclaimer is needed, for Bicknell's Thrushes were uncommonly loathe to sound off during this latter half of June and there might be many more, especially between Mount Head and Mount Sagamook, where I did not go. These birds had best be counted of a September morn, after resumption of all-out dawn vocalizing in the fall.

In hopes of hearing such an outcry, Susan Jewett and I camped near the summit of Carleton in September 1995 and hiked over to Sagamook. A summer-long drought had hit the area and we found no *Catharus* thrushes whatsoever. They had left or migrated early.

TV Tower Road Above Devils Elbow of Nepisiguit River

David S. Christie kindly directed Mrs. Marshall and me to the TV Tower Road, just north of Devils Elbow on the Nepisiguit River, where he had observed numerous Bicknell's Thrushes in previous years. From 25–27 June 1988 we found three pairs of Bicknell's Thrushes and one of Olive-backed Thrush within about 4 ha at 1900 feet altitude. The habitat is second-growth white spruce and balsam fir forest, well below the top of TV Hill (2148 feet) but above the white pine zone. We caught one of the males, wing chords 90/91 mm. This bird flew in from afar, parallel to the net, made a right-angled turn and struck the net in front of my face immediately upon hearing my one, imitated, two-toned whistle. These birds have mind-boggling accuracy and acuity of their stereophonic audio! Plants collected in this male's territory are *Abies balsamea*, *Picea glauca*, *P. marina*, *Betula papyrifera*, *Cornus canadensis*, *Kalmia angustifolia*, and *Rhododendron canadense* (University of Arizona Herbarium).

[Fundy National Park to Grand Manon]

From 19 through 23 June 1988 Elsie Marshall and I searched spruce habitats of Fundy National Park, Cape Enrage, and Grand Manon Island (including White Head) by playing tape recordings. We did not find the species, *Catharus minimus*, or either subspecies thereof particularly in these exact spots whence an isolated nest or a lone, singing "Gray-cheeked Thrush" had been reported by Maritime bird-watchers over the years: Fundy National Park on 19 June at Laverty Brook, Fire Tower, Caribou Plain; on 20 June, Laverty Bridge, Fire Tower, Caribou Plain (circumambulated), and with Rob Walker two miles along Coppermine Trail opposite Point Wolfe (Bay of Fundy) at dusk and return. At the Fire Tower (1200 feet, highest point in the Park) Hermit Thrushes, *Catharus guttatus*, ran

through their repertoire of calls including the high, descending whistle, in response to my imitated voiced whistle of the Bicknell's Thrush. They would not have so responded had they been acquainted with *bicknelli* in the area. On 21 June Cape Enrage was canvassed with Rob Walker, and then we visited Lavery Lake and Lavery Brook 950 m west of the bridge (site of a previous nest in a streamside alder supposed to be *bicknelli* [unlikely nest site] but photographs not diagnostic—David Christie pers. comm.). On Grand Manon Island, 22 June, I descended from Whistle Road to hike along both sides of Eel Brook in order to cover the site of a nest *on the ground* [unheard of for *bicknelli*] near the mouth of that brook during a previous summer (Brian Dalzell in litt.). I walked the loop trail of Eel Brook from the dump and visited Dark Harbour by dusk. On 23 June I searched Southern Head and White Head and found one Blackpoll Warbler, *Dendroica striata*, in a patch of spruce behind the big church at the Cape. One Blackpoll doth not a *bicknelli* habitat make, but a substantial population is certainly one requirement in the northeastern states [not in Canada fide Henri Ouellet and Anthony Erskine (pers. comms.)], and this lack of Blackpolls would appear to indict the summer records of supposed "Gray-cheeked Thrushes" for which this exercise was a follow-up.

There is, however, another explanation put forward by David Christie (pers. comm.) for the supposed summer lowland records at Fundy National Park and Grand Manon. These records are all from the 1970s and they were impossible to substantiate in hindsight during the 1980s. But David Christie is of the genuine opinion that his "Gray-cheeked Thrushes" were a lowland population of *bicknelli* that died out before 1980. The habitats seemed wrong to me, and Bicknell's Thrush has never dropped in on the nearby Kent Island only 5 miles from Grand Manon, where Blackpolls are common and have been studied for decades. Because Blackpolls are a constant associate of Bicknell's Thrush in its known New England mountain-top range, one should expect them to indicate suitable habitat on Kent. In spite of these reservations, I must declare that my New Brunswick colleagues have become experts on Bicknell's Thrush, if they were not already in the 1970s, as attested by David Christie's having recently discovered two undoubted breeding enclaves in the Nepisiguit River area. The blame for slighting necessary documentation for the 1970s records rests not with these New Brunswick investigators, but rather with the AOU Checklist (American Ornithologists' Union 1983), which made it impossible for them to realize they had something important that required verification.

Nova Scotia

French Mountain, 1400 Feet, Cape Breton Island

Elsie Marshall and I heard a pair at the Skyline Trail parking lot on French Mountain, Cape Breton Island, when it was nearly dark in the evening of 14 June 1982. A male sang in flight while another *bicknelli* countered with "bjew" calls from some low bushes beneath. We returned to the same spot 15–17 June 1988 to find a cluster of five territories within a white spruce and balsam fir forest divided by bogs, on level terrain at 1330 feet altitude, about 800 m long by 300 m wide. Estimate of territory size was complicated by one male's willingness to fly

250 m at a time just to protest an imitated call. The second tape-recorded song brought him into a net in the middle of his territory. His song and wing length (89 mm) are typical of *bicknelli*. Three thrush species share these open conifer groves in an order of abundance of Hermit Thrush (*Catharus guttatus*) first, Bicknell's second, and Olive-backed (*C. ustulatus swainsoni*) third. On both sides of the island we played tapes in beautiful seaside krummholz, such as is abundantly occupied by *minimus* in Newfoundland, without obtaining an answer.

[Cape Forchu, West Cape, Overton, Chebogue Point—Various Spruce-Balsam Forests at Low Elevation in Vicinity of Yarmouth; Map 3]

From 14–16 June 1992, and accompanied by Capt. Hubert G. Hall on the 16th, I searched low white spruce and balsam stands of Cape Forchu (specimen 13 June 1932 in Museum of Vertebrate Zoology—Appendix 1) and vicinity around Yarmouth without finding Bicknell's Thrush. Veerys responded to the imitated whistles, a sign that no Bicknell's Thrushes are about. The habitat is still suitable.

[Mud Island, 15 m, Off Yarmouth Harbour; Map 3 Enclosed Within the Dot for Nearby Seal Island]

I stayed on Mud Island from 17–20 June 1992, finding no Bicknell's Thrushes (but two singing Olive-backed). The island is flat, only a few feet above sea level. The black spruce trees, full of persistent cones (with irregular scale margins), are short, old, and open beneath, with a few *Sorbus americanus* among them. I found neither *Abies* nor *Picea glauca* that were reported by Erskine (1957). Vegetation is not reproducing due to introduced rabbits (native to the adjacent mainland) and sheep. Nevertheless the habitat is still ideal for Bicknell's Thrush, and the spruce forest of Seal Island visible to the south also looks good.

[Seal Island, Off Yarmouth Harbour; Map 3]

On Seal Island, Ian McLaren (in lit.) heard one bird call persistently in good habitat near the lighthouse on 18 July 1983. He found none from 30 June–3 July 1984 nor from 5–7 June 1987 but cautions that he did not make a proper search at dawn and dusk.

Maine

Katahdin, Baxter State Park; Map 4

At Baxter State Park, north base of Katahdin, Stephen Oliveri and I found Bicknell's Thrushes on 9–10 June 1992 from 2900 to 3500 feet in or near compact stands of red spruce and balsam fir. At dusk of the 9th and dawn of the 10th we heard one or two birds in the dense conifers on the northeast side of Chimney Pond (2900 feet altitude). They were not on territories there but were attracted down from the Dudley Trail krummholz by our loud whistles and tapes.

On the Saddle Trail rising westward from Chimney Pond into the Great Basin, I heard one "bzew" halfway up, in dense forest. Farther up, at 3500 feet, the conifers appear to end at the foot of the final incline. Here in the howling wind, between 19:35–21:10 hours, a little east of the crossing of Saddle Brook (so as to avoid the noise of the water), I heard perhaps a dozen Bicknell's Thrushes in the

two Sennheiser ME-80 microphones pointed in opposite directions. These birds sang after the Winter Wrens (*Troglodytes troglodytes*), Blackpolls, and Olive-backed Thrushes ceased for the night. There should be 50 or more in the lush, low conifers visible along that contour of majestic Great Basin.

I mentioned "along that contour" in my 1992 notes because in the failing light I thought I was at timberline and that the pale green birch and alder shrubbery from 3500 feet on up was not *bicknelli* habitat. But on 21 September 1994 after waiting for dawn at the same spot, I saw that the birches (*Betula papyrifera* var. *cordifolia*—Prof. Ron Davis in litt.) were losing their yellow leaves to reveal the normal, compact, low balsam fir thicket suitable for Bicknell's Thrushes almost all the way to the summit of Great Basin. From about 06:00–07:30 hours families of *bicknelli*, on their territories, called in relays. I recorded four or five individuals in each of four groups along 400 m from below the Saddle Trail crossing of Saddle Brook on up the slope of balsam fir (revealed under the leafless birches and alders). As at Percé the birds were still on territories, very vocal, and had not begun to migrate.

Mount Bigelow, 4150 Feet; Map 3

Roger Applegate and I found no Bicknell's Thrushes in a level tract of red spruce at 1800 feet altitude on the south face of Mount Bigelow on 9 June 1991. But after dark we heard one sing to the southeast, which could have been a knoll at 1500 feet altitude in secondary hardwood forest, unless the song was uttered in a long flight out from the summit.

New Hampshire: Mount Washington, 6290 Feet

Mount Washington

Roger Applegate and I drove up the toll road to Mount Washington at midday of 10 June 1991 and heard or saw four birds that responded to our recordings either with the descending whistle or the rattle. The Bicknell's Thrushes were in red spruce and balsam fir, from 4100 feet altitude in woods tall enough to walk under, down to 3434 feet in tall forest. Surrounding the shoulders of this massif is abundant suitable habitat, but it is dispersed as patches at disparate altitudes on adjacent slopes, according to whether they face north or south.

Vermont

[Butler Lodge, 2900 Feet]

The Green Mountain Club's Butler Lodge is located far down the southwest slope of Mount Mansfield on the Long Trail. During its first season, in 1935, Martha and George Wallace were resident custodians of the Lodge, which therefore was either the core study area or merely the base camp for that summer's research leading to George Wallace's doctoral dissertation on Bicknell's Thrush. A photograph of Butler Lodge in 1935 (Wallace 1979:46) shows in back of it the conifer thicket resembling timberline krummholz, grown up after a fire. This thicket may well have clothed much of the steep, rocky southwest slope from the Lodge upward so as to harbor a substantial population of the bird.

"On September 6, 1935, at sunrise there was an abundance of calling [Bicknell's] thrushes about Butler Lodge . . ." (Wallace 1939:368). That is Wallace's

only statement that connects this low, fire-induced, conifer thicket with actual thrushes. It is one of the two statements in the entire dissertation that connects any particular place on Mansfield with a Bicknell's Thrush, the other being Taylor Lodge (to be mentioned later). It is proof positive that Bicknell's Thrushes had territories around Butler Lodge because I have ample evidence to show that they remain on their family territories and do not move downslope in September. They would not have moved down from The Forehead. The reason for these elaborate caveats is that our northern, spotted *Catharus* thrushes simply vanish during the molting period from late July through August, creating a discontinuity in Wallace's or anybody else's observations. The birds never surface again on their breeding area until the next spring except that after the molt Swainson's Thrush calls during the midnight rally to migrate (see below under "Group Migration") and Bicknell's Thrush resumes calling, singing, and rattling in September (see above under Québec: Gaspé).

With ideal weather during 3–4 September 1992 I heard no Bicknell's Thrushes around Butler, where the mixed forest is now much taller and more open than in the 1935 photograph. Are we to suppose that the Lodge was surrounded by a large population now gone merely because the thicket grew into a tall forest? Did Martha Wallace find all the nests right here? The statement about resumption of calling on 6 September 1935 opens the distinct possibility that Butler Lodge is the actual study site. But other photographs (Wallace 1979) of far-flung locations along the summit and the fact that both Martha and George Wallace were young, long-legged, and spry as mountain goats leads me to believe that the study area, the nests, and the local distribution of Bicknell's Thrush encompassed the entire summit of Mansfield—the reclining giant along the north-to-south axis from Adam's Apple to The Forehead—as well as down the northeast slope to Taylor Lodge and down the southwest to Butler Lodge. My three hours' toil in the rain to ascend from Butler to The Octagon might well have been a 30-minute stroll for Martha and George Wallace.

Mount Mansfield, 4393 Feet

On Mount Mansfield, 18–20 June 1981, Martha Hays Cooper and I estimated 17 territories in 32 ha, all lying west of the Octagon, from the pass (3500 ft) to The Nose. Up to seven birds could be heard at the same time, first calling, then singing from perch and flight. Seven territories of *C. ustulatus* surrounded the Octagon.

On 2 July 1984 I returned with Roger Clapp, who replicated Cooper's habitat photographs, showing no change on this lee side. West slope conifers in the distance were dead but still standing. We found the Bicknell's Thrush population as dense as before, now unaccountably shifted to the east of the Octagon, whence *ustulatus* had relocated down the south slope. We estimated 22 territories in 32 ha, arranged as only four in the 1981 area toward The Nose and 18 from around The Octagon eastward to the hairpin turn in the Toll Road.

Again on Mount Mansfield, 28–29 July 1992 with Chris Rimmer and others, I recorded a few calls west of the Octagon and saw a juvenile in krummholz of the Amherst Trail, whose regular food call was recorded. It flew well, had a bobbed tail, and was spotted all over. The good habitat east of the Octagon (3500 feet) had

been removed through widening of the ski runs. Only three bushes of red spruce were seen on the west slope, although they are abundant along the summit ridge where the acid clouds blow right across and cannot tarry against the foliage.

From 28 August to the night of 7 September 1992 I tested Wallace's novel observation of a spectacular resumption of vocalizing by Bicknell's Thrush in the first week of September, after the molt. [I attempted a test of whether this is an attribute of the entire species by visiting Port-aux-Basques, Newfoundland, in early September 1994, when I encountered only one individual.] In our experience with others of the genus, adult *Catharus* simply disappear during the August molt, cannot be found by netting, and do not show up again until the next summer. Thus it was with considerable excitement that Mrs. Marshall and I witnessed a build-up of vocalizing at Mount Mansfield from one dusk call on 28 August to a fusillade of calls by six birds at dawn and dusk of 4 September and finally seven or more callers at dusk of 7 September with full songs and a flight song. Our observations and recordings were mostly at the sheltered spring, 3850 feet, northwest of The Octagon. Laura Nagy (pers. comm.) reported that these thrushes were still loud and clear on 15–16 September 1992 at Mansfield.

In 1992 I found Bicknell's Thrushes no farther down the slopes of Mount Mansfield than 3600 feet immediately above Taft Lodge, where I enticed one to call at dusk of 5 September and four or five more in a dawn outburst on 6 September that provided calls, adult song, and juvenile song. The Green Mountain Club's Taft Lodge marks the lower species boundary on the east face of Mansfield just as it did in May 1935 when Martha and George Wallace slogged through waist-high snow to see their first Bicknell's Thrush at Taft Lodge (Wallace 1979).

Camels Hump, 4083 Feet; Map 5

Roger Clapp and I visited Camels Hump 29 June–1 July 1984 and mapped Bicknell's Thrushes from the Long Trail and Burroughs Trail. The birds at lowest altitude were in the north slope forest and spring at Gorham Lodge, 3400 feet altitude, whence they were deployed upward and heard or seen from the Long Trail ascending toward the south. Another colony occupied a nice conifer grove along the east base of the peak; and a group of territories was in a sheltered gully on the west, in mixed balsam fir and red spruce. Judging from Roger Clapp's panoramic series of kodachrome slides around Camels Hump, showing all the dead spruce that were still standing in 1984, a good half of the *bicknelli* habitat there with its birds was gone—that is, from the west slope.

Again on 23–26 June 1993, Jonathan Gibson and I with difficulty mapped 12 birds (Map 6). They could be induced to call once or twice by imitating the whistle, and a faint song from the ear-phones would produce only one song or song flight by birds within hearing of it, at late dusk at 3900 feet altitude on the north end of Camels Hump above the little clearing at the trail junction. As at Mount Carleton (above) the birds may have been at a stage of their reproductive cycle during which further territorial advertisement was not a priority. Bicknell's Thrush was silent and practically gone from around Gorham Lodge so that I was unable to trace song traditions from my 1984 recordings there.

Killington Peak, 4235 Feet

Killington Peak showed healthy forest in all directions when Roger Clapp and I rode the ski lift through torrential rain and lightning on 3 July 1984. After the storm we had only enough time to hear calls from nine territories in about 12 ha of fir forest all around the summit—a small fraction of the probable population.

New York**Whiteface, 4867 Feet, Adirondack Mountains above Lake Placid**

I spent 27–28 July 1992 around the 4000 foot level of Franklin Delano Roosevelt's splendid road up Whiteface. Using directional microphones I heard brief dusk calling of six Bicknell's Thrushes beneath the east hairpin turn (4300 feet, toward the ski area), and at dawn four more below the west hairpin (3950 feet, toward Lake Placid). A single was whistled up above a picnic stop at 3800 feet and another above a parking spot at 3500 feet altitude. This was of course far past the season of song. Every one of these 12 birds, in coniferous thicket habitat between 3500 feet and 4300 feet altitude clearly demonstrated the choice by Bicknell's Thrush of the greenest, most luxuriant, healthy, sheltered stands of low red spruce and balsam fir, mostly on slopes facing northeast.

Porter Mountain, 4059 Feet, Adirondack Mountains Above Keene Valley, Essex County

Having located two Bicknell's Thrush territories at the top of Porter Mountain during midday and poor weather in June 1992, Wesley and Vicki Lanyon encouraged me to undertake a larger census. From an Eden of colorful mixed vegetation overrun with flocks of juvenile passerines I stepped into the lush, dense, depressed, summit growth of red spruce and balsam fir. Here in three days (24–26 July 1992) I found only the same two birds: one that glared silently at the earphones 20 m west of the eastern of the two rock outcrops, the second that spontaneously called at dusk of the 25th, in the territory 95 m east of the first, in mixed growth of taller conifers and birches.

Slide Mountain, 4200 feet, Catskill Mountains, Ulster County

On porcupine-infested Slide Mountain, type locality of *Catharus minimus bicknelli*, we found the answer to the question "Can Bicknell's Thrush exist in pure balsam fir?" Indeed it can and does, in astonishing density. Martha Hays Cooper and I, ascending from the west, found on 22–23 July 1992 that the change from deciduous forest is complete at the 3900-foot contour, whence the trail passes eastward through 1.4 km of gorgeous, low, balsam firs along the summit. At the west end of this level, final part of the trail, we stopped to squeak up a warbler and got instead the piercing "bzew" of a Bicknell's Thrush, which looked us over and then flew to a birch branch over the trail and stood tall, showing in side view what seemed on this cloudy day to be a bicolor pattern of brown back contrasting with clear gray flanks like a Veery. No other *bicknelli* were interested in imitated or taped audio. We had to wait for spontaneous bursts of calling (and a few songs and a flight song) that happened around dusk many times in the clear calm

atmosphere, and again many times during the next early morning in fog, drizzle, and wind. Hampered by rain, we were able to census only the last 200 m of trail, from John Burrough's big rock on west past the summit, amounting to about four hectares that included grassy openings around the rock and site of the former cabin (photograph in Bull 1974, figure 74) where Burroughs (1895) was also harrassed all night by ravening porcupines 100 years ago. We obtain from our sketch maps 8 birds for the evening and 9 for the next morning, but they were moving fast and constantly changing pitch and inflection of their calls. Two amicable birds screeched inside the same balsam where I tried to shelter the microphones; one of the birds dropped to the needle-strewn ground and hopped along as thrushes are supposed to do—the first time I have seen this in *bicknelli*, although *minimus* in 1968 foraged thus on campus paths at the University of Alaska. All the birds we found were from 3840 feet altitude to the summit. We conclude first that this entire, intense, vocal ritual at the start of the molt has nothing to do with territory and that all family members are taking part, and second, that red spruce has disappeared due to acid cloud since visits of Parkes (1954:162) to the "summit spruce zone" and of Robert W. Dickerman (pers. comm.) in 1985 "a few spruce."

[Massachusetts]

Greylock, 3487 Feet; Map 3]

Greylock, when visited 3–4 July 1984 by Roger Clapp and myself, supported good balsam firs but every spruce tree was damaged, regardless of age. We found no *bicknelli* in 1.5 km along the summit and Saddleball Ridge, but the loss of this small colony antedates the acid rain problem. The specimen (Appendix) was taken by Walter Faxon in 1888; one or two songs in the Library of Natural Sounds from 8 and 10 June 1952 by Peter Paul Kellogg at Greylock are identifiable as *bicknelli*.

[Cuba]

I have not yet visited Cuba but I feel it is important to try the method invented by Tomás Vargas there, even though Cuban ornithologists consider Bicknell's Thrush nonexistent in winter and only an extremely rare migrant (in the Botanical Garden, Garrido and Montaña 1975). This is similar to the beliefs of authorities on Hispaniola, where we have proved apparent rarity to be only an expression of the extremely low profile maintained by the birds on their winter territories. The only known specimens, from the Botanical Garden (Appendix 1), are apparently fall migrants heading for Hispaniola. But then nobody expected them in the Botanical Garden at Santo Domingo either.

Republica Dominicana

Sierra Bahoruco, 5576 to 5740 feet

On the north slope of Sierra Bahoruco above El Aguacate is an open forest of pines laden with Spanish moss, where logging was stopped by presidential decree after World War II. Ravines are filled with a thick broad-leaved forest over leaf litter and ferns, and laced with wirelike bamboo vines where a trail passes eastward

from a hairpin turn in the highway. While camping in this shady part from 14–17 February 1990, Tomás Vargas and I heard spontaneous calls of *bicknelli* at dusk (18:30 h) on the 14th and tried everywhere to elicit responses to imitated loud whistles. At 09:30 h on the 15th we played very faint songs from a headset in front of a net (because we had no speaker). Immediately a bird from the pines uphill shot over the top of the net, then came back uphill and into the net at 1 m above the ground (Appendix). While the captive was in a bag, faint playback prompted a Bicknell's Thrush to call loudly down slope. Then an aggressive bird perched on a branch 2.4 m above ground in front of the net and stood tall, wings drooping, pumping the tail like a Hermit Thrush, and all puffed up as if angry about a territory. Upon release, the captive perched two meters away, to be tape-recorded and sketched (Color Plate 1). At 18:50 h a distant call was recorded in response to songs played in the headset, which apparently was the fourth bird along this 533 m of shaded trail. Mike Entwistle, of London, saw two more about 150 m apart, actively feeding at dusk on the road within 500 m of the start of our netting trail. This made six territories in a linear census of one kilometer. The faint playback worked but once; no thrush responded along the same course on 16 February.

National Botanical Garden, 2050 Feet, Santo Domingo

Back in Santo Domingo on 17 February 1990, at the Jardín Botánico Nacional in restored natural broadleaf forest, I again played songs in the headset placed in trees. Two solitary, silent birds responded, in shady ravines 197 m apart; each one crouched in a horizontal posture while glaring at the phones for a moment, then vanished. They would not respond a second time, that day or on the 20th.

[Puerto Rico]

From 11–21 March 1986 José Antonio Colón, Elsie Marshall and I visited various habitats, played loud songs and calls on a tape recorder, and found no *Catharus* thrushes. After the Hispaniolan experience, however, another attempt was made by Colón and me from 4–14 March 1991, using subdued songs played in various natural habitats including the spot in Guanica Forest where Colón and Chandler Robbins netted a Bicknell's Thrush in 1985 (Appendix 1). No cryptic population was discovered by crafty playing of faint tapes through small earphones.

ANALYSIS OF SONGS AND CALLS OF *CATHARUS MINIMUS*

The screeching songs and calls of the Northern, Newfoundland, and Bicknell's Gray-cheeked Thrushes are poured forth with such immense energy at such high pitch that they carry through and can be heard above the roaring winds and flailing rains of their summer homes. Although the human ear discerns only a dozen or so different calls, these short exclamations constitute what seems to be an infinite series when viewed as sonagrams. The songs, finite in number, may more suitably introduce this chapter even though they are of mind-boggling complexity. I beg the liberty of using subspecific names to facilitate comparisons among the three areas of tape recordings: *aliciae* for Northern Gray-cheeked Thrush vocalizations from Siberia, Alaska, and Manitoba (LNS); *minimus* for Newfoundland Gray-cheeked Thrush from Tabatière (LNS) and Newfoundland; and *bicknelli* for Bicknell's Thrush from southern Québec, Maritimes, New England, New York, and Dominican Republic.

SONGS

Gray-cheeked and Bicknell's Thrushes, like the Black-capped Vireo (*Vireo atricapillus*) and the Song Sparrow (*Melospiza melodia*), have song variety nearing infinity, if you include the whole species. Unlike a Song Sparrow, whose repertoire consists of many compositions that are easily distinguishable from each other, the three or four scores performed by a particular Northern, Newfoundland, or Bicknell's Gray-cheeked Thrush screech past our ears at such a ferocious pace, with two sets of hundreds of notes passing by in two and one-half seconds, that the human ear (mine at least) does not ordinarily distinguish among the songs except to discern the upward versus downward inflection at the end as well as the short version of the shortest score. Thus it seems necessary to resort to sonagrams in order to see what is going on.

In his paper entitled "A comparative study of 'advertising song' in the *Hylocichla* thrushes" Robert Carrington Stein (1956) showed, but did not comment upon, the differences between songs of Northern and Bicknell's Gray-cheeked Thrushes. Bob Stein followed in the footsteps of Arthur A. Allen and Peter Paul Kellogg at the Laboratory of Ornithology, Cornell University. He made superb recordings and exquisite sonagrams. His was the first Nagra tape recorder I had seen; I could hardly believe my ears when he played on it the seemingly alive songs of the Colima Warbler (*Vermivora crissalis*) that he had just recorded at Big Bend National Park. In his understatement, Stein (1956:509) passes on to us little, unobtrusive clues based on 23 songs of four individual Gray-cheeked Thrushes:

"Some of the phrases show the complex arrangement of short notes, with more than one note being sounded simultaneously."

"Individual birds repeated individual patterns regularly, although not in succession."

"However, because of the complex arrangement of phrases, the songs of these individuals were distinct."

Fifty-six individual birds singing 180 different songs (scores) rendered on 1002 sonagrams later, I had triumphantly "discovered" that each *Catharus minimus* sings in two-part harmony, that each male has in his brain the scores for three or four songs none of which is performed twice in succession, and that each such repertoire is individually unique like a set of fingerprints. Upon concluding that massive task and rereading Stein (1956), I sheepishly admit that I have done little more than put frosting on Bob Stein's cake. But these songs on my eight hours, 23 minutes, and 45 seconds of tape recordings are of such exceptional interest musically that I shall go on at length to extoll the singers and to compare their recitals. In this I take a quite different tack from Stein, who relied solely upon the visually manifest sonagram for his critique. It is as if a music critic should comment upon a recital only after going to the library and looking at the published musical scores by the composers of the songs that were sung; the duration, pitch, and sequence of the various notes would be compared among the different compositions. I on the other hand base my critique on the aural sensation of these exhilarating sounds and I use the sonagrams merely to look for similarities and differences and to distinguish among individual singers. My plan for the exposition of this complicated topic is to present first the general attributes seen when sonagrams of all the songs are looked at; second to treat just the singers to whom I could definitely attribute a suite of three or four scores so that I can explain what a singer actually does. Then in a third section I shall dispense with the sonagrams in order to report on times of singing, territorial singing, group singing, juvenile practice singing, and renewal of singing after the fall molt.

Entire Sample of Songs

Materials

My goal was to make a sonagram of every song that was sung close enough to my microphones to make a legible sonagram. But with some close singers I made only enough sonagrams to be sure I had the entire repertoire. Thus in the eight hours, 23 minutes and 45 seconds of my own tapes, I made 1002 sonagrams of whole songs. When I spread out the sonagrams of a particular recording session, I found duplication corresponding to the number of compositions being sung, at three or four scores per singer. In each set of duplicates the sonagrams are identical, even though hundreds of notes, incredible leaps in pitch, two voices, and complex trills are involved. I picked the clearest sonagram of the set as an exemplary score for that particular piece of music. There were 180 such unique scores, most of which I could attribute to individual performers. But 53 of them emanated from thickets of conifers inside of which choruses were performed and

I could not assign repertoires to individuals because they kept trading places. I include the 53 in this analysis of the sample because they add to the understanding of what the songs are like.

While analyzing the total 180 kinds of songs (scores) I discovered the rather bizarre construction of songs from Newfoundland and determined to sweeten the pot with the 163 sonagrams representing all songs and 52 scores by 20 singers in the 56 minutes and 56 seconds of tape recordings copied for me by the Library of Natural Sounds, Dr. Henri Ouellet, and the Borror Laboratory of Bioacoustics. I hoped that these recordings by other laboratories from intervening areas not represented in my sample would show trends toward the Newfoundland situation: Manitoba, North Shore of the St. Lawrence, and southern Québec. What then do we find of interest and what regional or racial differences can we discern among the combined total of 1165 sonagrams of 232 scores recited by the 76 performers from Siberia, Alaska, Manitoba, and Newfoundland southward to Slide Mountain, New York?

Pitch Range

Songs of *bicknelli* make a narrower and often longer sonagram than those of the northern subspecies. Songs of all three taxa top out at 8 KHz, making a convenient reference for comparing all sonagrams as to upper limit of pitch, at about b^5 , 7902 Hz. Whereas the lower limit of Part IV in *aliciae* and *minimus* approaches c^4 at 2093 Hz, most *bicknelli* and some *minimus* descend no lower than $f\sharp^4$ at 2960 Hz. The smaller bird thus has the narrower range but not a higher soprano register.

Obbligato Voices

Birds have two separate vocal membranes that vibrate, one at the start of each bronchus where it divides from its partner at the end of the esophagus. Greenewaldt (1968) provided the physical and anatomical evidence and gave examples showing that some birds produce two tones simultaneously, one from each bronchial membrane. Stein (1956) had already noted that two tones that are not harmonics can appear simultaneously upon the sonagram. Many birds, however, control the two membranes together so that they vibrate in unison. But any song of a Gray-cheeked Thrush shows the two independent voices on a sonagram. Their traces are not an octave apart, as are harmonics of a single tone. This is readily evident on my sonagrams because octaves are equidistant upon the vertical scale through the use of the logarithmic display. The higher-pitched voice is obviously not double the pitch of the lower, as would be so were it an harmonic. Furthermore, the two visual traces of the thrush take different directions, at different pitches, and sometimes they even cross each other (Fig. 2). I shall refer to them as the soprano voice and the alto voice, as seen on the sonagrams. To the human ear I think this polyphony enhances the rich but very wild, abandoned character of the song although the dual tones cannot be discerned because of the fast pace of this frenetic outpouring of hundreds of notes at high pitch within a song lasting only two and one-half seconds. As for harmonics, most sonagrams of bird songs do not show even the first octave above the fundamental unless it is

very strong or unless the amplitude of the printer is strained in order to show the faint first parts of the song.

Components of the Song

We begin with Ouellet's (1993b) four subdivisions of the song. They are not separated by rests, but they can be discerned from differences in loudness, pitch, and insertion of a grace note. Ouellet's part I is the introduction, consisting of a low, short, unmusical "chuck" or a series of "chucks." Sometimes a singer, especially if it is *bicknelli*, will generate considerable excitement and expectation as it utters a long, accelerating series of chucks prior to unleashing the full song. This optional part I is really not musical song. But neither is the chuck a call note, for it is never uttered except as introduction to the song. Some individual singers omit this part entirely; others substitute a single lisping note that is the same as the introductory note used by the Veery. In Fig. 2 of examples, the sonagrams from Conche illustrate the chuck, which is the first note of songs f, g, and h. The lisping note that is usually an optional replacement for the series of chucks is the first phrase of score e from Conche.

Part II has an immense number of notes beginning at high pitch and mostly of vertical orientation on the sonagram. Some of these batches of near-vertical notes incline downward and slightly to the right (Fig. 2, Conche f, first phrase after the chuck); others incline to the left (Fig. 2, Conche g, first phrase after the chuck). These notes, and in fact the entire part II of the Gray-cheeked Thrush song impart a wild, screeching sound. (On sonagrams, the more vertical the trace, the more is the sound like noise; the more horizontal the trace, the more is it like a musical tone.) One can perhaps imagine that part II is a distant clangor of silvery chimes. One thrush that really sounds like silvery chimes is the Brown-backed Solitaire, *Myadestes obscurus*. I made sonagrams of this species' song and found they are recited in a single voice and that they shed no light on the song of the Gray-cheeked Thrush. Part II is softer than the remaining two parts of the song. In most songs, it has few or no sustained notes (horizontal on the sonograph) or long trills. It is infinitely varied—much more so than the remaining two parts of the song, which are fairly stereotyped. The variety of part II is usually what identifies a score as being different from any other.

In Parts III and IV the volume is turned up as sustained notes, long and extremely complex trills, and grace notes command the score. In their standard form, parts III and IV both consist of a grace note followed by a long phrase in which the soprano and alto lines coverage upon one or the others' pitch and then participate equally in an elaborate trill. Sonagrams made from the closest singers look as if the trill is a continuous wavy line for each voice whereas the sustained notes appear really to be a very rapid succession of individual notes that are meshed together in traces from birds farther off.

Grace notes are the key to understanding the songs of Northern, Newfoundland, and Bicknell's Gray-cheeked Thrushes. One or more grace notes can be heard in every song. To my ears, the grace note sounds like stuttering, and for a very good reason: The sound of the grace note is duplicated at the start of the following long chord. In some songs the grace note is uttered twice or three times

before its final sounding as it merges into the sustained chord. That is real stuttering. For this discussion I consider to be true grace notes only those short notes that are repeated as they merge into the sustained chord of a part III or IV. Rarely does the final phrase of the song lack an introductory grace note—14 of my 180 scores lack it, to be exact, and in most of those few, part IV is simply missing altogether—in the shortest song of the repertoire.

Conclusions from the Study of All Available Sonagrams

The songs of Gray-cheeked Thrushes are composed on a predictable pattern with two obbligate voices: part I of introductory chucks or a lisping note, part II of complex but highly organized batteries of notes in rather a squealing quality, parts III and IV each of a sustained chord in which the two voices converge in pitch and combine in a trill. In part IV this chord with trill is always preceded by a grace note and the trill is prolonged. The grace note is what gives the hesitation or stuttering near the end of the song. It is the interruption that Wallace (1939) declares is so characteristic of Bicknell's Thrush. The grace note introducing part IV likewise characterizes the songs of Northern and Newfoundland Gray-cheeked Thrushes. Pronounced geographic variation in parts III and IV of the song corresponds to the three populations *aliciae*, *minimus*, and *bicknelli*. These racial differences are constant and predictable. Alaskan, etc. *aliciae* is very consistent in having for part III a high-pitched chord that rises in pitch before the trill, whereas lower-pitched part IV descends and starts with a grace note. Newfoundland and Tabatière *minimus* have a crazy mixed-up part III but always end with a regular part IV the same as that of *aliciae*. The low, descending part IV is therefore characteristic of all the northern populations. But New England, etc. *bicknelli* presents a distinctive score in which part III is the same as part IV of both Northern populations whereas the *bicknelli* part IV is the same as the middle of the Northern Gray-cheek (*aliciae*). Ouellet (1993) does not mention that the difference between *bicknelli* and the Northern Gray-cheeked Thrushes is merely a trading of places between parts III and IV. This difference was put up for all the world to see in the excellent figures by Stein (1956), who did not comment on it either.

Necessity for a Different Terminology

Since part III of *aliciae* and *minimus* really is *bicknelli* part IV, serious ambiguity results from any attempt to apply Dr. Ouellet's terminology to the northern taxa in comparisons. Therefore I must invent a simpler system in which the same musical phrases will receive the same letter symbol and the position of each phrase will be shown by its chronological order in a sequence of three letters. Leaving out the introductory chucks (the same in all populations), I represent the beginning, middle, and end of the musical part of the song by the three letters, the grace note by an apostrophe, and a missing part by a zero. The letter "a" stands for the first third of the song. Four kinds of phrases can occupy the middle third and the final third, with or without a grace note. I designate them b, c, d, and e. In "b" after the grace note and its repetition the soprano and alto voices both ascend in pitch as they converge before combining forces in the trill. In "c" these two voices descend in pitch. The entire "b" is always at higher pitch than the entire "c." Two other kinds of phrases can occupy the middle of the song. In "d" the

soprano voice descends while the alto ascends. In “e” both voices move in parallel, rising at first, leveling off, and then falling just before the trill. These variants are shown in Fig. 3.

Sequence of Phrases in the Northern Gray-Cheeked Thrush

Most *aliciae* sing a score of ab’c. Of my 85 different *aliciae* songs 77 end in the low, descending c and 76 of these have the appropriate one or two grace notes before the c. The sequence ab’c is used in 59 scores, a’b’c in 15, and a0’c in one with no middle phrase. Now ignoring grace notes, in 67 scores b occupies the middle, 60 scores have the sequence abc, 14 adc, one aec, and four ab0. Put another way for the effect on the human ear of b and c respectively, 66 of the scores have a high-pitched ascending middle and 77 of them have a lower-pitched descending finale.

Sequence of Phrases in the Newfoundland Gray-Cheeked Thrush

A lesser proportion of *minimus* sing ab’c, with many Part III positions occupied by d or e. Of the 46 kinds of songs I recorded, 44 end in c, all but four of which have the proper one or two grace notes. Thus nearly all the songs end properly as for all northern populations with the ‘c. But the middle section is most irregular, and instead of ‘b there may be d (9) or e (11) or even c (5), with or without grace notes, and sometimes the middle phrase is left out altogether (5). Because a majority (26) of my 46 scores are from the narrow zone of overlap with the Veery, I have pondered whether this proximity to the close relative, this bombardment with incessant, monotonous Veery singing, has somehow corrupted the ability of Gray-cheeks to learn their parental songs. A few phrases in the sonagrams indeed somewhat resemble the Veery’s, but so do some from *bicknelli* on Mt. Carleton, New Brunswick, way above contact with Veerys. My recordings of two individuals at Conche, near the tip of the Northern Peninsula, are the most remote from the overlap zone at Port-aux-Basques, as are the Library of Natural Sounds five scores from La Tabatière, Québec but these songs are as aberrant as the rest from Newfoundland. By aberrant I mean only in comparison to the much more regular scores of the birds from Siberia, Alaska, and Manitoba. From the standpoint of the listener, only 12 of my 46 *minimus* scores rise (b) in the middle section, whereas 43 of them descend (c) at the end as is proper for all the northern populations.

Sequence of Phrases in Bicknell’s Thrush

In *bicknelli*, however, the order is changed to ac’b. Of the 45 scores represented in my sample, 44 end in the high-pitched, rising b, all but four of which are introduced by the proper one or two grace notes. But a perplexing oddity now appears, for in five of these scores the terminal b is not as high-pitched as usual and the long trill declines in pitch so as to sound a little like the northern populations. As for the lower-pitched, descending c, it occupies the middle in 40 of the scores; one score has d and three have e as the middle of the song. A discerning listener would hear a low descending middle followed by a higher-pitched ascending termination in nearly all *bicknelli* songs.

Songs of Individual Gray-Cheeked Thrushes

Let us now turn to the individual singers—those to whom I could definitely assign a repertoire because I recorded their performance while they were close or

singing solo. Did any of these soloists have phrases, songs, or an entire repertoire found in another bird? In what consecutive order did they perform their songs?

Materials

Setting aside the choruses, we find in my tape recordings 67 scores sung by 20 *aliciae*, 21 scores sung by 5 *minimus*, and 29 scores recited by 9 *bicknelli* individuals. Copies from Library of Natural Sounds, Dr. Henri Ouellet, and Borror Laboratory of Bioacoustics include no choruses and all those individuals can be used for supplementary information: 19 scores of six *aliciae*, five scores of two *minimus* (one incomplete), and 28 scores of 12 *bicknelli*.

I have recorded several *Catharus minimus* at the same territory on different days, as did Arthur A. Allen and Peter Paul Kellogg at Churchill, Manitoba. The songs and repertoire of a Gray-cheeked Thrush are the same whenever they are recorded, and I have no doubt that they remain fixed for the lifetime of the individual. My repeated attempts to return and prove this have fallen on bad luck mostly the result of development and environmental degradation. In 1993 Bicknell's Thrushes were no longer present at Gorham Lodge, where I had recorded an excellent performance terminated by rain in 1984. Too long a wait from 1980 explains my inability to find the same recitals at Goldstream Bridge, Fairbanks, Alaska, in 1994 and I simply could not find the other territories of 1980 because of development and my failure to bring along my field maps. At Table Mountain, northwest of Port-aux-Basques, Newfoundland, where group singing and flight songs seemed to be the rule and the chorus was at a different place each night, I could never locate a singer from the previous year. Revisiting Mt. Mansfield, Vermont, in 1992 for this purpose was a disaster because widening of the ski runs had eliminated the population that Roger Clapp and I had studied eight years before on the east side of the Octagon. And so on.

Characteristics of the Repertoires

As mentioned before, the song is characterized by a degree of musical complexity approached by no other bird, and this is partly due to both syringes sounding independently in polyphony, as shown by diverging, simultaneous voices. Such complexity allows that no two birds share a song or a suite of songs except for some birds that certainly must have been nest mates or belong to the same family. The usual repertoire consists of three or four songs. I assume that the brain of the singer carries a template or "score" for each of these songs probably learned from the father. Parts II and III (omitting part I from this discussion) are as different in the three or four scores as they are among individuals of that subspecies. But often part IV is the same in two songs of the same repertoire and indeed it may be seen in very similar form in various members of the entire subspecies. The glaring and frustrating fact that part IV is never the same in all three or four scores of the repertoire is what prevented me from assigning scores to individual members of choruses. In the shortest song, part IV is optional—aborted or replaced by the lisping note (the same one seen as an optional introduction in part I). Some individuals always leave off part IV of the shortest song. Such a loss transforms an *aliciae* song into a *bicknelli* by having it end in the higher-pitched ascending chord and trill.

Part II is the least conservative of the three parts and it is mainly responsible for the fingerprintlike individuality of each repertoire. However, an annoying situation cropped up with regard to Part II in singers that had an unusually long part II. That is, they could shave off a short phrase or two phrases at the beginning so that the song could start (right after the last chuck) at one or two places after the beginning of the full score. Loath to assign different letters to the various remainders, because they were otherwise identical, I designated them with the same letter but with a superscript. Then when I noted the order of performance I was horrified to see (Table 1) that a singer was treating each variant as a different song! He did not perform according to my rules. That is, he permitted an A' song to follow an A song, for instance.

Sequence of Songs

The rules of performance are that never shall a song be sung twice in succession and that only the shortest song can be aborted so as to lose its last phrase. The longer song, which I usually designate as A, alternates for a while with the next longest, B, before the C is sounded. Table 1 shows some typical sequences in the longest recitals that I recorded.

Duplication of the Repertoires

At Goldstream Bridge of Ballaine Road, Fairbanks, in 1980 I recorded *aliciae* of territory number 1 early in the morning while Snipes (*Gallinago gallinago*) were still winnowing and before traffic began. This thrush sang in willows above the mud bank of a ditch parallel to the bridge on a territory he shared with one or more Swainson's Thrushes. From the far end of the bridge I could hear *aliciae* number 2, who seemed to be singing the same songs as number 1. Sonagrams confirmed my suspicion in consecutive songs on the tape, all those of number 2 being clean and all those of number 1 double due to a close echo apparently bouncing between the bridge and the bank. Aside from the doubling, the repertoire and individual songs are indistinguishable to my eye. These two males may well be father and son.

At 15 km northwest of Port-aux-Basques, Newfoundland, in 1981 I recorded under less than ideal conditions, from the edge of the Trans-Canada Highway, two next-door neighbor Gray-cheeks that were obviously repeating each others' songs. Trucks kept passing by and the Gray-cheeks were at a distance. I could not climb to the krummholz where they sang because of a vertical roadcut with a canal at the base. But I recorded anyway because this was like finding the Holy Grail—the contact between Gray-cheeked and Veery Thrushes (in alders of the canal)—for which Martha Hays Cooper, Elsie Marshall, and I had been searching all summer. I call this locality the east base of South Twin Hill. Sonagrams and stereo listening reveal this as a chorus of three with a lot of calling between interrupted periods of singing. Several of the scores are aberrant and have a part IV that does not follow the rules. Some of the sonagrams show three overlapping songs. Two of the songs, which I designated as scores A and B on the sonagrams, are the most frequently sung and each exists in two forms that are very subtly different from each other. They must represent the two singers that belong to the same family. I cannot assign the remaining songs nor can I tell which forms of A

ALICIAE

	CBAC	ACBACBACBACBA		average interval
Provideniya	ba'a'b	b'a'b'-aca'-ba	a'-b'-aca'ba	6 seconds
Round Lake	ABCACBACBACBACBACBACB	B	B	10
Goldstream 2	BCA	ACB	C AC	9
			BACBABACBACBACBACBA	BC
Maclaren	BC	CADBADCADBCDDBA	ABADCADBC	7.8

MINIMUS

Conche 1	DA	CD	CD	AC''BAC''C'D	9
Conche 2	efe	hge	hge	hge	5
Table Mt. 1	aca	b	a	badca'bdaca'bdaa'b	6
Table Mt. 1982	367	56376	367357	7357	6

BICKNELLI

[illegible]

TABLE 1 Succession of Songs by Selected Individuals, from Sonograms

Superscript means a different opening note or phrase for Part II. The minus sign means a note or phrase is left out of the end of Part IV or Part IV is left out.

and B are paired with the same singer because the criterion of succession is disabled by interruptions and trucks. But I surmise that the slight differences between the two versions of A and of B mean that these two birds learned their songs from different nestings by the same family. They might be father and son. Chris Rimmer and I have hoped to test the concept of family resemblance in song by tape-recording known relatives from his banded population at Mt. Mansfield. So far, unfortunately, although he has found many interesting returns from former summers, he has not found brothers nor fathers and sons.

My most noteworthy duplication of repertoires is a tape I made of the Sithylemenkat Lake *aliciae* of 1980 who has three songs in his repertoire that are the same as three of the four that had been sung by the Ace Lake bird 233 km to the southeast at the University of Alaska, Fairbanks, in 1968 (Fig. 4). Again, subtle differences perceived only on the sonagrams suggest a degree of relationship equivalent to the Newfoundland duo and less than that expected of nest mates. If we should assume that the two singers recorded 12 years and many miles apart are closely related, then we have an instance of far-reaching mixing by members of a population, by overshooting or falling short of their natal destination as they return from South America in the spring. I am extremely grateful for corroboration of this theory by two specimens of Newfoundland *minimus* that were collected in summer within populations of Bicknell's Thrush far south of their proper summer home. They are from Mt. Washington, New Hampshire, 11 July in the Museum of Comparative Zoology and from Percé, Québec, 14 June in the Canadian Museum of Nature (Appendix 1). Conceivably these birds had become members of the local population of an entirely different subspecies—perhaps to be viewed as an argument in favor of regarding them as conspecific.

Duplication of Whole Songs

While I was recording the *aliciae* at Sithylemenkat Lake in Alaska, a neighboring bird in the distance sang one song, the first part of which is decipherable to show it exactly the same as the closer bird's score B. These two could be very close relatives. Although my second visit to Goldstream Bridge, Fairbanks, in 1994 failed to produce similar repertoires, one complete song was the same. Score A of the northwest bird is similar to score A of bird number 2 from 1980 at almost the same spot but on the opposite side of Ballaine Road. Sandra Gaunt recorded some Gray-cheeks at Churchill in 1996 so that I could see if any songs recorded there in 1954 by Arthur A. Allen and Peter Paul Kellogg were still being sung. One score, B, of Borrer Lab bird 17992 is the same as the Library of Natural Sounds bird's score B except that part II starts with a different phrase and the grace-note of part III is missing. Borrer 21279 score C is almost the same as LNS-C. Borrer 17992 score B also resembles Borrer Lab 21282 score A, rather remote in time and place; only the first phrase of part II is different.

For the Newfoundland *minimus* I have one song shared exactly the same by Table Mountain male number 2 of 1981 and the male of 1982 at almost the same spot. With my bad fortune at re-recording any individual Bicknell's Thrushes, I am gratified to have examples from Dr. Ouellet's cassette: bird 8 from 35 km north of Saint Urbain has score D exactly the same, down to the last detail, as

bird number 10 score D from 42 km north; similarly bird 7 score C from 35 km north shows a family resemblance to bird 10 score A from 42 km north of Saint Urbain—these two songs differ in very slight details and have different beginning phrases to part II.

Duplication of Parts of Songs

A widely recurring part III among Bicknell's Thrushes is found in my sonagrams for Mt. Mégantic bird 1 score A of Dr. Ouellet and my Camels Hump male's scores A and B. Another shared chord among *bicknelli* is one I designated as c superscript 2. It occurs in my scores from Mt. Carleton ABCD, Katahdin BC, Mt. Mansfield #1 ABC, and Dr. Ouellet's scores from St. Urbain bird #3-A (the same as Ouellet's #4) and Val d'Espoir bird #2 scores C and D. Other similarities in songs and parts of songs can be seen in my sonagrams, especially in parts III and IV of *bicknelli* and in *aliciae* from Churchill, Manitoba. That population, according to Dr. H. Elliott McClure (pers. comm.) would be quite thin, as only patches of the required spruce are scattered here and there across the tundra. Those birds and others across the continent have some similar patterns but the individual notes are different. Such songs and parts might sound alike to the human ear. They show us that given the rather set scheme of the composition, the possible variations may not approach infinity after all.

Implications for Field Identification

If you are in the field and you hear the whole repertoire of a Gray-cheeked Thrush (that might be included in the first three or four songs), you have a 100% chance of correctly distinguishing *bicknelli* from *aliciae* cum *minimus* by the pitch and inflection of the terminal part IV as stressed by Ouellet (1993). This would be useful especially for migrants that occasionally sing. But if you hear only one song you might have stumbled upon score C of *aliciae* in which part IV is left off, apparently transforming the song into that of *bicknelli* (Fig. 2). Then in my recordings of Bicknell's Thrush I find four scores from the Mt. Mansfield chorus (7, 8, 10, and 16) and one from the Mt. Carleton chase (second song of louder bird) in which Part IV, following a normal part III ('c or c), is of fairly low pitch with a trill that ascends but little or actually declines in pitch. These birds sound quite like *aliciae* and *minimus*. Ouellet (1993) chose such a song as an example in his figure 7B that clearly shows descent of the final trill. I have determined from viewing Dr. Ouellet's cassette on the Uniscan II that his 7B is actually the 16th song of *bicknelli* number 1 from Mont Mégantic, Québec. The down-turned trill is distinctive of the 16th song as is the "chebec" of the Least Flycatcher (*Empidonax minimus*) almost a second after the thrush.

Time and Place of Singing

First, remember that Martha and George Wallace discovered by watching nests that the female Bicknell's Thrush sings (Wallace 1939). This review of the circumstances of singing by Gray-cheeked Thrushes derives from my field observations, preserved in my notebooks and tape workups archived at the library of the Division of Birds, Smithsonian Institution. Sonagrams do not enter the argument. The male concentrates his entire attention upon a song recital and does

not interrupt it with bouts of calling; members of a chorus are equally sustained, with session lasting perhaps 15 minutes to a half hour or more depending on time of day and season. Season is the prime determiner as to whether or not there will be territorial singing, group singing, family practice, or no singing. So I shall recount my impressions arranged from late May through early September. As background, let me refer to the four other species of northern spotted thrushes in whose schedules I am better versed. John Aldrich directed me to his study area at Gaudineer's Knob in *Picea rubens* and *Rhododendron maximum* at the summit of the Allegheny Mountains on Highway 250 in West Virginia, where he had heard simultaneous singing of Wood Thrushes, Swainson's Thrushes, Veerys, and Hermit Thrushes (Stewart and Aldrich 1949). I have studied them there in summers of 1980, 1987, 1988, 1990, 1991, 1993, 1994, and 1998 with assistance from Rodger Clapp, Louise Emmons, Elsie Marshall, Roberto Phillips, and Emilie Hood. (This is also the southernmost, small colony of balsam fir.) Hermit Thrushes engage in territorial singing all summer and can be seen even in late July feeding a second brood. As for the other three species, in late May is much singing but the Swainson's are moving about and may still be in migration. In early June is strict territorial singing that gives way to group singing in early July. By late July these dense populations have dropped off the face of the earth and are simply not there, as proved by extensive netting, for which I had permission of the West Virginia authorities. Now I shall attempt the same schedule with the Gray-cheeked Thrush, which is complicated by differences in day length over the vast range. The only May experience that Elsie Marshall and I had was at Table Mountain, Newfoundland. Snow was still everywhere when we arrived near the end of the month to find no singing by the Swainson's, Veerys, and *minimus* Thrushes there. After the snow melted, birds suddenly were singing on their territories in morning and evening, with no sign of any conflict between species or within species in order to stake out those territories. For *bicknelli* strict territorial singing prevailed in June with song flights witnessed or heard, some at treetop level at dusk, some high in the air after dark. In July were mostly group songfests. At Table Mountain (*minimus*) these were at late dusk after the group singing of Swainson's Thrushes and Veerys was over. The *minimus* above my camp would launch forth in the gloom, singing steadily as they went to start up or join a songfest on the other side of the glacial canyon. These nonterritorial group singings were at a different part of the canyon every night, which frustrated my attempts to set up microphones in anticipation. (On the other hand, the Veery and Olive-backed songfests beneath Table Mountain are by stationary groups called upon to sing only two or three evenings a week, so that the chorus moves from place to place though the birds stay put.) In Siberia and Alaska there were no *aliciae* song flights at all, because it was never dark. At the Maclaren River on the Denali Highway, Alaska, Elsie Marshall and I thought our July visit was doomed until we had to get up in the middle of the night to drive into the main lodge to use the bathroom. Then we heard the mighty chorus of Gray-cheeked Thrushes in the dwarf birch and waist-high willow brush. That time of dawn/dusk around one and two A.M. is doubly good for group, nonterritorial singing. I am tempted to call it singing for the fun of it. By August in Newfoundland the three species of thrushes had dropped off the face

of the earth. Local people said they had gone over to the other side of the mountains to get berries. I did preserve a few road kills of molting immature Swainson's Thrushes though.

After reading Wallace's (1939) account of resumption of calling in early September by *bicknelli*, Elsie Marshall and I visited Mt. Mansfield in Vermont with Chris Rimmer and his volunteers, and sure enough, within a few days during the first week of September 1992, Bicknell's Thrushes were in full cry, briefly, at dawn and dusk with singing and a song flight by the 7th. I heard the same September calling at Katahdin in Maine and at Percé, Québec, but at Percé considerable singing and practice singing of the young occurred. This type of resumed strenuous activity is made possible by the completion of the molt prior to migration southward.

CALLS

Calls of the Species *Catharus minimus* as a Whole

Wallace (1949:212) explains that "The most characteristic call note of Bicknell's thrush is a harsh, penetrating, slurred whistle, similar to but harsher and higher-pitched than the familiar *weu* of the veery. At times it approaches the sharply whistled call of the red-winged blackbird. Most other call notes are a modification of the typical one, adapted to express a variety of moods: high and piercing when used as a scolding or alarm note, lowered to an inquisitive *pe-irt* when used to express curiosity, or warbled more or less musically when the adults are at the nest." Although I have not heard adults at the nest, I can pronounce Wallace's description as precisely fitting the Northern and Newfoundland Gray-cheeked Thrushes just as well as Bicknell's. I describe the call as a high-pitched, descending *bjew* capable of infinite modification forbidden to the stereotyped calling of all other *Catharus* thrushes except the Veery. My imitation is performed as a whistle upon which my voice is superimposed; it has a galvanizing effect upon these birds in summer but is met with stony silence in winter. In areas devoid of Gray-cheeked and Bicknell's Thrushes it is often answered by Hermit Thrushes and Veerys, who confuse it with their own descending whistles. And that is good evidence that no *Catharus minimus* are in the area; if they were, the Hermit Thrushes and Veerys would have learned the call. Proof is found at the territorial overlap between *minimus* and *fuscescens* at Port-aux-Basques, Newfoundland, where the two species are familiar with, and oblivious to each other's calls. Away from that area, any Veery (at Cape Forchu, Nova Scotia, and Doaktown, New Brunswick) or Hermit Thrush (*Catharus guttatus* at the Fire Tower, Fundy National Park, New Brunswick) that confused my Gray-cheek imitation with its own descending, voiced whistle, clearly indicated its unfamiliarity with Bicknell's Thrushes locally.

Results from Field Observations

The Northern, Newfoundland, and Bicknell's Gray-cheeked Thrushes do not ordinarily mix calls with songs. When I have tape-recorded a bird that I can actually see when it sings, it just sings. I think that the calls heard during a song recital are uttered by birds other than the singer. This brings us to the major

drawback in understanding the calls of Gray-cheeks. They call from behind the scenes, inside the thicket, and I have neither a clue as to what interactions are going on, if any (with two exceptions, below), nor what prompts the inevitable change in tone. After calling for 15 seconds or more at a few seconds' interval between calls, the bird suddenly changes tone or pitch or both. And these changes go on for minutes (Fig. 5). One receives the impression of near infinite variety heard in these changes from one batch of calls to the next. All are of ear-splitting intensity and are of higher pitch than the calls of other *Catharus* thrushes.

By freakish good luck I was privileged actually to witness and to hear under natural conditions two behavior interactions by Gray-cheeked Thrushes involving calls. There was no tape playback, no imitated call, no manipulation of the birds, who were oblivious of my presence or that of my car. These incidents involved aggression, probably toward a neighboring male who encroached on the territory, in mid-June when territorial defense is still paramount. I heard the buzz only during one prolonged encounter between males from territories 2 and 3 at the north end of the Ballaine Road bridge over Goldstream, northwest of Fairbanks, Alaska, 21 June 1980. I had seen male number 2 fly into territory 3 while I was myself standing inside the little spruce bog that constituted territory 3. Probably male 3 was doing the chasing, but the birds were close together as I followed their swift flight with the microphones to record about 30 seconds of buzzing. They dashed at waist height back and forth and around me. Sonagrams show the burry sound's trace (Fig. 6). I never again heard the buzz, which therefore pertains only to *aliciae* so far in my material. The second aggressive encounter was at French Mountain, Cape Breton National Park, 17 June 1988. It involves the rattle call, much like the rattle of the Veery, and equivalent to the "tidaddy" of Swainson's Thrush but less musical. Elsie Marshall and I were driving slowly along a narrow track by a ravine when I heard the rattle from the ravine. I stopped the car, saw the Bicknell's Thrush that had uttered the call, and noticed the retreat of a second *bicknelli* swiftly disappearing on the opposite side of the road ahead. The remaining bird still maintained the frozen aggressive posture—head, tail, and bill in line inclined slightly downward, and beak gaping to show the bright yellow interior. He was close by in the ravine, at the level of my eye so that I was able to sketch him from memory shortly thereafter, as shown in Color Plate 1. Dilger (1956a p. 333) had a similar close encounter on Whiteface Mountain, New York, 10 June 1953; he designates this hostile display as "Gaping from Horizontal Stretch." I heard rattle calls at Camels Hump, Vermont, on 29 June 1984, at French Mountain, Nova Scotia on 15 June 1988 (different bird from the above), and Mt. Washington, New Hampshire on 10 June 1991 when Roger Applegate noted that this is the usual response to a tape recording (lacking the rattle) at midday. In September 1994 the rattle call became prominent: A family of *bicknelli* responded to taped songs with that call on Mt. Jacques-Cartier, Gaspésie on 13 September, but at Percé on the Gaspé Peninsula on 18 September and Katahdin, Maine, on the 20th, the rattle was uttered frequently in the choruses of calls (without taped provocation). I did not hear the rattle in Siberia, Alaska, or Newfoundland; therefore my knowledge of it is confined to *bicknelli*. Dr. Henri Ouellet has heard it from one of the northern forms, but says it sounds somewhat different from the rattle of *bicknelli*. He finds it an uncommon call of *bicknelli* that is heard mostly in the fall (pers. comm.).

Tape-Recorded Materials

From my own tapes and cassettes I made sonagrams of only the closest callers, so as to get the details. I would make one good sonagram or two from a batch of calls that sounded all the same. Then when the bird shifted to a different call, I would make one or two of that, and so on. In anticipation of the unexpected average differences among subspecies that I shall explain, I admit that this is perhaps not a highly defensible statistical method. But it is in my opinion evenhanded and it shows that in my sample *bicknelli* used certain types of calls more frequently than did the other two populations.

Of Gray-cheeks and Bicknell's Thrushes calling from the ground or from vegetation I made sonagrams of 604 calls, usually five to a half sonagram sheet, divided lengthwise. By shifting the paper past the first call, I would record another and add it so as to eliminate the intervals between calls that would be represented by blank paper. These 604 break down into 135 calls from 11 localities in Alaska and one in Siberia of *aliciae*, 150 from five localities of Newfoundland *minimus*, and 302 from 14 localities in the northeastern range of *bicknelli* plus 17 from wintering *bicknelli* in the Dominican Republic. Also I made sonagrams of overhead migrants, only three, much to my sorrow considering my intensive efforts to record them along likely migration routes at night. However I am grateful to Bill Evans for sending me a cassette of his overhead migrants: *aliciae* from Minnesota, of which I made 36 sonagrams; and *bicknelli* over Florida, of which I made 14 sonagrams. My on-the-ground sonagrams are augmented by five calls of *minimus* from LNS; 18 of *aliciae* at Churchill, Manitoba from the Borror Lab and LNS; and 16 of *bicknelli* from Québec, Mt. Mansfield, and Whiteface in the collections from Dr. Ouellet and LNS. The grand total is 698 calls listened to carefully and looked at on paper in support of the following most confusingly complex subject. We shall classify the calls, see which populations use each kind the most, and shall compare the pitch of the same call as used by the little bird, *bicknelli*, as against the big bird, *aliciae*.

Results from Analysis of the Tapes

I sorted all the sonagrams of the calls into as many categories as I could discern conveniently. They are shown in Fig. 6. Most calls start explosively and if they were recorded close enough they show two nearly vertical spikes on the sonagram—presumably one from each syringeal membrane. These spikes sound the initial consonants in my clumsy representations of the calls, “specyer, bejeeyu, jeer, and beyuk” for categories 1, 2, 3, and 4. Category 1 is “Initial Peak” with 11 subtypes. The long part of the call is a simple descent in pitch from the peak of the spike. “Humped,” category 2 with five subtypes, rises gradually after a short decline from the spike and then descends. In “Arch,” category 3 with six subtypes, is a single ascent then gradual decline in pitch. Category 4 with seven subtypes is for “Sour,” the two-toned calls that sound like the Veery, only higher. Category 5 with 11 subtypes gathers the odd, softer calls “Buzz, Rattle,” as well as various lisping syllables that resemble or are identical to the “lisp,” which is the fledgeling’s food call as well as the optional replacement to the chuck (part I of the song).

Table 2 of the sonagrams I made shows the number of calls in each category by locality. In a general way my sample of *aliciae* favored the use of categories 2










1: Initial Peak									
	1a	1b	1c	1d	1e	1f	1g	1h	1j
									
Northern Gray-cheeked Thrush									
Siberia									
Alaska	8	2	6			1			
Manitoba		4	1						
Minnesota sky	1		10		2	6			
<i>aliciae</i> totals	9	6	17		2	7			
Newfoundland Gray-cheeked Thrush									
Tabatière	4								
Newfoundland	8	4	1		25	14			
<i>minimus</i> totals	12	4	1		25	14			
Bicknell's Thrush									
Québec	2	2	1	1				1	1
Gaspé Sky				1					
Nova Scotia				2					
New Brunswick						1	6	1	
Maine	2				4	1	3		
New Hampshire	1								
Vermont	27	12	4	3	4	8	27	20	13
New York	6	14			2		4	1	
Florida Sky	3			3	6	1			
Dominican Rep.				2			1		
<i>bicknelli</i> totals	41	28	5	12	16	11	41	23	14

TABLE 2. Calls

All sonograms made by the author for types 1–4 are used including those from tapes sent by Dr. Ouellet, Mr. Evans, Borror Bioacoustic Laboratory, and Library of Natural Sounds.















2: Humped						3: Arch							
1n	1o	2a	2b	2c	2d	2e	3a	3b	3d	3e	3g	3h	3i
													
		36	9	7			11	24	12	2		1	
	1	2	1	3	1			4					
		5	4		1			2		1			2
	1	43	14	10	2		11	30	12	3		1	2
				16		3	1	7	5		33	6	
				16		3	1	7	5		33	5	
				1				1	1				
					2								
										3			
1												1	
										2			
3		13	4		5				2	14			
2										2		2	
	1												
	9												
6	10	13	4	1	7			1	3	21		3	

TABLE 2. (continued)







4: Two-toned Sour							
	4a	4b	4c	4g	4h	4j	4n
							
Northern Gray-cheeked Thrush							
Siberia	1						
Alaska	13	2	3				
Manitoba							
Minnesota sky	1	3					
<i>aliciae</i> totals	15	5	3				
Newfoundland Gray-cheeked Thrush							
Tabatière					1		
Newfoundland		1		5	13		
<i>minimus</i> totals		1		5	14		
Bicknell's Thrush							
Québec	1						
Gaspé Sky							
Nova Scotia							
New Brunswick							
Maine							
New Hampshire							
Vermont	6	3		1		8	
New York		6					1
Florida Sky							
Dominican Rep.		1					2
<i>bicknelli</i> totals	7	10		1		8	3

TABLE 2. (continued)

(humped) and 3 (arch) whereas *minimus* emphasized 1 (initial peak) and 3 (arch) equally. The preponderance of *bicknelli* calls in my sampling were the type 1 (initial peak). Notice in Table 2 that all three taxa can use almost any of the large selection of calls. But for the purpose of comparing pitch among them, I must select a call that is used in identical form by all three. A glance at the table shows few candidates for that role among the various subtypes. In Table 3 I compare the average pitch for the few calls shared by all three taxa or at least by one of the northern forms compared with *bicknelli*. The first category is the high-pitched 1a that sounds like “speeyer” and *aliciae* averages only a semitone below the other two taxa. The humped call 2a that sounds like “bejeeyu” is lower in *aliciae* than *bicknelli* by a little more than a semitone. The “jeer” call of arch, 3d, was higher by a full tone in *aliciae*. Finally, for category 4, the sour note “bi yuk” that sounds like a Veery, is about the same pitch in *aliciae* and *bicknelli*. I read the highest pitch of the musical, more horizontal portion of the call by eye against the 1000 Hz guide lines automatically scribed by the Sona-Graph. With the wide band trace I estimated the midsection with allowance for the logarithmic scale so that the reading would be about two-thirds of the way upward through the trace. I estimated pitches thus only to the hundreds of cycles per second. Table 3 also shows the percentage appearance in my sample of the various main categories by population as summarized above. When the same type of call is compared, then *bicknelli* differs by a paltry semitone or a little more (Table 3).

Calls of Overhead Migrants at Night

I listened to overhead migrants in the headset of my tape recorder and attempted to record on tape the calls of migrating Gray-cheeked and Bicknell’s Thrushes in early May and late September during the first hour before dawn. In many of these attempts I was assisted by Greg Scheib, Elsie Marshall, Tiz Williamson, or Susan Jewett. We tried a ridge of the Allegheny Mountains of West Virginia, a long valley in those mountains, Skyline Mountain in Virginia, Falls Church in Virginia; shorelines such as Port-aux-Basques, Newfoundland (where migrants have to touch down at dawn), Tenants Harbor, Maine, Nouvelle and Gaspé on Chaleur Bay, and Blackwater National Wildlife Refuge, Maryland; and the Delaware River, the Hudson River, and the Cascapedia River—one of the favorite sites visited by S. C. Ball (1952). We paid especial attention to the Hudson River, because there is a large series of specimens of migrating Newfoundland and Bicknell’s Gray-cheeks in the National Museum of Natural History collected at Ft. Lee, New Jersey, showing that the Hudson was a major route and Ft. Lee a principal touchdown for the species, at least in the early part of the century. In the mountains, Tenants Harbor, Falls Church, and Blackwater we heard nothing at all and in the rest of the localities were innumerable Swainson’s Thrushes, many Veerys, and a few Hermit Thrushes as well as other songbirds—warblers, tanagers, etc.

At the coastal village of Mont Saint-Pierre on the northwestern shore of the Gaspé Peninsula I did record three calls of Bicknell’s Thrushes among the hordes of Swainson’s Thrushes flying southwest, parallel to the coast. Ball’s (1952) consummate expertise would have us believe that only *bicknelli*, which performs radial migration down river valleys, descending the Shick-Shock Mountains, and





Peak pitch estimated by eye against kHz guide lines on sonagram, 2/3rds up through the thickness of the trace, to nearest 100 Hz									
	<div>kHz</div> <div><div><div>7</div><div>6</div><div>5</div><div>4</div><div>3</div><div>2</div></div></div>	<div></div> <div>speaker</div> <div>① Initial peak</div>	<div></div> <div>bejeeyu</div> <div>② Humped</div>	<div></div> <div>jeer</div> <div>③ Arch</div>	<div></div> <div>biyuk or sour</div> <div>④ Tow-toned</div>				
138	17	12%	52	38%	50	36%	19	14%	
<i>aliciae</i>	la average 4613 Hz n = 8 d ⁵ -		2a av 4358 Hz n = 36 c ^{#5} -		3d av 4325 Hz n = 12 c ^{#5} -		4a av 4000 Hz n = 14 b ⁴		
142	52	37%	19	13%	52	37%	19	13%	
<i>minimus</i>	la average 4925 Hz n = 8 e ^{b5} -				3d av 4040 Hz n = 5 b ⁴ +				
266	177	67%	33	12%	27	10%	29	11%	
<i>bicknelli</i>	la average 4994 Hz n = 35 e ^{b5} +		2a av 4638 n = 13 d ⁵ -		3d av 4067 Hz n = 3 b ⁴ +		4a av 3929 Hz n = 7 b ⁴		
Totals	546	246	104	129	67				

TABLE 3. Percentage of Use and Peak Pitch of Calls, by Population, Using the 546 Loud Calls (not Type 5) on Sonagrams from Author's Tapes

then heading along the coast, could be expected as a migrant on the Gaspé. This makes good sense because there are no *minimus* on Anacostia Island to the north, *minimus* from northeastern Québec should proceed along the north shore of the St. Lawrence, and all the *minimus* from Newfoundland have to cross the water to Nova Scotia and thence to South America coastally. Because my overhead migrant calls are so few, I am fortunate in the generosity of William R. Evans, who provided me with a copy of his tapes reported in Evans (1994), from which I made sonagrams of 14 *bicknelli* calls from Florida and 36 of *aliciae* from Minnesota.

Evans (1994 figures 1a and b) shows two entirely different types of calls. That for Florida migrant *bicknelli* is my category 1 subtype a, whereas that for Minnesota *aliciae* is my category 3, subtype b. Unfortunately the small sizes of my and Evans' samples permits few comparisons of the pitch of identical calls. For 1a, *bicknelli* is a major third higher than *aliciae*; with 1e, *bicknelli* exceeds by a minor third; and with 2d, the two are practically the same pitch. Treating categories 1 and 2 as wholes, *bicknelli* 1 is a major third above *aliciae*, which bears out Evans' finding of higher pitch for migrating *bicknelli* calls, here differing by almost 1000 Hz. But the 2s are the same pitch for the two taxa.

It remains to compare the overhead migrant calls with the calls made on the ground. My meagre calls from *bicknelli* overhead at Mont Saint-Pierre are the proper shape for their two subtypes 1d and 2d as recorded on the ground. But 1d ($n = 7$) and 2d ($n = 15$) are not common in my ground sample and I have never heard them uttered by the northern subspecies *aliciae* and *minimus*. Sobering indeed is the fickle nature of sampling, which shows little correspondance between overhead and ground calls when we move on to the Evans tape. And Evans' Minnesota migrants have added a unique subtype 3i to the known repertoire—completely unrepresented in my large ground sample. These calls, in the categories I assigned them, are heard most frequently in Evans' tape: For *bicknelli* the five 1a calls average 5480 Hz at peak pitch contrasted with 4994 Hz for my ground sample ($n = 35$), a difference of one tone on the musical scale. For *aliciae*, call 1c is rare in my sample, average pitch 3717 Hz ($n = 6$) and lower than Evans' most common call ($n = 11$ averaging 4209 Hz) by a semitone; my rarest call, 1f ($n = 1$ 4100 Hz) is the same pitch as Evans' sample of six; for 2a, Evans has four calls averaging 4075 Hz compared to my sample in which 2a is one of the commonest calls, averaging less than a semitone higher at 4327 Hz; and finally Evans' four calls 2b (average 3850 Hz) are more than a full tone lower than my sample of nine at 4422 Hz. It is difficult to conclude from present information whether or not a migrating group of these thrushes is reserving or improvising particular calls for nocturnal migration, different from those of the ground.

DISCUSSION

IDENTIFYING AND CURATING THE *CATHARUS* COLLECTION IN THE MUSEUM

Three goals to be achieved are first, look through your entire *Catharus* collection in order to retrieve all the *Catharus minimus* specimens in your museum that Wallace (1939) identified and listed in his appendix; get Wallace's names on these labels, either *Catharus minimus minimus* for the big ones or *C. m. bicknelli* for the little ones. Second, identify all your other *Catharus minimus* specimens using the Wallace-identified specimens as standards. Be guided by Wallace's analysis of measurements by which he declared the overlap zone of wing chord to be from 95–97 mm and remember that Northern or Newfoundland Gray-cheeks this small are extremely rare. Be sure to take out the dark-backed, western Veerys by the criterion of Phillips (1991) pertaining to the color of the sides of breast and flanks. These Veerys are identified by the contrast between the brown sides of the chest and the pure gray flanks, whereas the sides of chest and flanks are unicolored brown like the back in Gray-cheeks and Bicknell's Thrushes. Third, change obsolete names on the labels and be sure that the subspecies name *minimus* is used only for the big birds and that the subspecies name *bicknelli* is used only for the little ones. Horrendous mixups in major museums are the result of past nomenclatural changes by which the three trivial names, *aliciae*, *bicknelli*, and *minimus* have played musical chairs with the three populations.

American Ornithologists' Union (1886:342 and second edition 1895:317-318) gives us *Turdus aliciae* Baird, Gray-cheeked Thrush "south, in winter to Costa Rica" and *T. a. bicknelli* (Ridgw.) Bicknell's Thrush "In summer, mountainous parts of the Northeastern States (Catskills, White Mountains, etc.) and Nova Scotia, migrating south in winter." The third edition (AOU 1910:360) has *Hylocichla aliciae* (Baird) with *H. a. aliciae* (Baird) Gray-cheeked Thrush "winters in Colombia, Ecuador, Peru, Venezuela, and British Guiana" and *H. a. bicknelli* Ridgway, Bicknell's Thrush that "winters in Haiti and probably northern South America." AOU fourth edition (1931:260) gives us *Hylocichla minima aliciae* (Baird), Gray-cheeked Thrush and *H. m. minima* (Lafresnaye), Bicknell's Thrush, which "winters in Haiti and Venezuela." The fifth edition (AOU 1957:441) offers up *Hylocichla minima* (Lafresnaye), Gray-cheeked Thrush with *H. m. minima* (Lafresnaye), Gray-cheeked Thrush, and *H. m. bicknelli* Ridgway, Bicknell's Thrush, which "winters in Haiti (Morne Malanga), Dominican Republic (Puerto Plata, Aguacate, Sánchez) and western and southern Venezuela." The sixth edition (AOU 1983:555) uses only one name, *Catharus minimus* (Lafresnaye), Gray-cheeked Thrush, and after a long paragraph on the breeding distribution from Siberia to Newfoundland

and eastern New York (Catskills) to Nova Scotia (Seal and Mud islands), declares that the species “*Winters* in South America from Colombia, Venezuela (also Trinidad) and Guyana south to northern Peru and northwestern Brazil, casually in Hispaniola and north in Middle America (mostly on the Caribbean slope) to Costa Rica.” [The Hispaniolan birds are not casual; rather, they are the entire wintering population of Bicknell’s Thrush. The Costa Rican and other Middle American specimens are not midwinter and are therefore migrants.] The seventh edition (AOU 1998) has *Catharus minimus*, Gray-cheeked Thrush, and *Catharus bicknelli*, Bicknell’s Thrush.

As an example of the havoc caused by labels bearing various permutations of the above three names trading places with the three populations (Alaska, Newfoundland, New England), let me cite the Smithsonian collection at the United States National Museum. In the late 1970s a curator in the Fish and Wildlife Service, Museum Section, decreed that the *Catharus* collection be organised as three subspecies, *aliciae*, *minimus*, and *bicknelli* and within those categories by sex first, then date, because illustrators need comparable plumages next to each other rather than contiguous localities. The only precedent I can find for dividing the Northern from Newfoundland Gray-cheeked Thrushes is Godfrey (1966) [and Phillips (1991) later]. After the specimens were arranged in that scheme, it became apparent to me in May 1995 that the nonbreeding specimens had been assigned to subspecies simply according to whatever checklist name was already on the label, and that depended solely on which checklist was in vogue at the time the bird was catalogued. Thus we find [incorrectly] both *minimus* and *aliciae* in abundance on the Mississippi flyway (with some *bicknelli*) and all three taxa migrating along the Atlantic Coast states and wintering in Central and South America.

In order to make any sense out of the *Catharus minimus* collection, in May 1995 I first checked size and coloration to find agreement with Wallace’s results. Then I combined the sexes, divided the species into only two subspecies (big *minimus* and little *bicknelli*), and organised the species into breeding-ground continental *minimus* (Alaska to Québec), breeding-ground Newfoundland *minimus*, breeding-ground *bicknelli*, Atlantic states migrant *bicknelli*, Central United States migrant *minimus*, Atlantic states migrant *minimus*, Central and South American migrant *minimus*, and finally, South American wintering *minimus*. Each of those categories (except Latin America) was organised by states and provinces from west to east and from north to south. Within each state or province I ran the fall birds first, arranged from dark to pale back, followed by the summer or spring birds also arranged from dark to pale back. The Latin American migrants are arranged the same way, fall first, with countries combined. South American wintering birds are treated as a unit, dark to pale. On their breeding areas, the most important, freshly moulting birds (July to September), come first, followed by the worn and faded summer birds (May to August). This is not a prescription for general curating; rather, it is a plan tailored for the particular situation with *Catharus minimus* in this particular museum, which has a huge abundance of migrants, substantial summer birds, some fall molting birds still on the breeding ground (only one for Newfoundland), a handful of South American wintering *minimus*, and no wintering *bicknelli*.

FIELD IDENTIFICATION

Wallace (in Bent's "Life Histories," 1949) says it is impossible. Wallace's measurements show 95–97 mm as the overlap zone for wing chord. Most but not all *bicknelli* could be identified by the yellow basal half of the lower mandible if they would ever get out of the thicket and sit still. A complete song that goes up at the end belongs to a Bicknell's Thrush. But songs that go down at the end do not all belong to the Northern and Newfoundland populations. Dr. Ouellet and I have each recorded at least one *bicknelli* whose part IV is at low pitch and the trill actually descends. An aborted or incomplete Gray-cheek song can end on the middle phrase that goes up like the terminal phrase of a Bicknell's Thrush song. You need three or four consecutive, taped, complete songs to tell the repertoire of an individual *Catharus minimus* of either subspecies. Unless you have unlimited time to memorize one individual's output, you cannot recognize his songs "A, B, and C" except possibly the short one, "C." I myself have to resort to sonagrams. It is, however, perfectly easy to recognize whether all three (some individuals have four) are inflected upward or downward in the last phrase. Singing by Bicknell's Thrush apparently takes place only on the summer nesting area, which is already established by measurement of the wing chord or by recorded songs as extending from southern Québec and the Maritime Provinces through the mountains of New England and New York. Similarly, Northern and Newfoundland Gray-cheeked Thrushes are throughout the northern nesting area from the Kolyma River, Siberia, to Newfoundland-Labrador (complete song down at the end). I have not heard the song in migration or in winter, but Dr. Gary Graves has, in spring in Virginia (pers. comm.).

DELINEATION OF THE HABITAT

The species, *Catharus minimus*, is little known because of its remote, near-timberline distribution and its unpredictable habitat preference. Its occurrence in limited enclaves is an expression not only of dispersion of its favorite vegetation but of choice by the birds for the most lush or dense groves or thickets. Intervening plants of the same species are skipped over. However, the Alaskan bush habitat of willows and dwarf birch is continuous for miles and miles along the Denali Highway.

The high mountain habitat to which Bicknell's Thrush closely adheres in New York, Vermont, and New Hampshire is easy to recognize and to define. It is a dense low woods of red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*), brightened around the edges with *Cornus canadensis*, *Oxalis*, *Stellaria*, and *Coptis groenlandica*. In Maine, two or three perplexing birds heard at low elevation do not upset the concept of a huge, uncounted population on Katahdin. Then in Canada, where white spruce (*Picea glauca*), *Ledum groenlandicum*, *Kalmia angustifolia*, and *Cladina alpestris* are added to the habitat, our birds begin to spurn the rules—perhaps of necessity since there is insufficient high altitude vegetation. Yet on Cape Breton they eschew the equally good seaside coniferous woods, known to be proper habitat from the former occurrence of the thrush on Magdalen, Mud, and Seal Islands.

Unpredictably, Bicknell's Thrush shares a few, tall, conifer groves with Swainson's and Hermit Thrushes on Cape Breton Island. When we skip on over to Newfoundland, we find chaos, with the Gray-cheeked Thrush in "colonies." Inland, enclaves within the few remaining tall spruce-fir forests can be many kilometers apart; ascent to shorter, timberline growth guarantees no birds save at Conche. Yet a narrow band of territories exists along the west coastline, in seaside balsam and spruce, or used to exist before the coast highway cut through it. In my study area 15 km northwest of Port-aux-Basques, the bird really stays in low conifers (an unusually rich and varied thicket to be sure) in three enclaves: the first is by the seashore, the second is timberline of one (not both) of the twin hills, and the third is at the upper limit of forest conifers, among birches, half-way up the north-facing slope (but not on the opposite side) of the canyon beneath Table Mountain. This last mixture brings Veerys and Gray-cheeked Thrushes together.

Finally, in the Alaskan interior I found the Gray-cheeked Thrush in low, dense, willow thickets at stream junctions and around ponds. This habitat is extremely interrupted to force the bird into the usual, limited enclaves characterizing the eastern populations. Large tracts of tall willows are unoccupied. Thus I found the species in 10 small willow thickets around Fairbanks, and throughout large areas of low willows at Eagle and Sithylenkat Lake. At Bettles they were common in thickets of alder and willow and also spilled over into forest of low stature consisting of deciduous trees mixed with spruce. At Central, Alaska, was an enclave of at least two territories in level black spruce over a cushion of moss and lichens. The continuous landscape of dwarf birch (*Betula glandularis*) above timber line but below tundra provides for the only continuous population of *Catharus minimus* that I have ever found. It is along the eastern part of the Denali Highway on the Alaska Range. I found no end to the Gray-cheeked Thrushes along the portion of the highway that Elsie Marshall and I covered in June 1994 and July 1995.

My experience shows that *Catharus minimus*, considering all three taxa as that species, favors willows, alders, and dwarf birch in the west (*aliciae*) and conifer thickets in the east (*minimus* and *bicknelli*). I would shrink from using such habitat differences as a species criterion as Ouellet (1993) does, because, in the same genus, the Hermit Thrush and Swainson's Thrush show the same sort of distinction between east and west as does the Gray-cheeked Thrush. In the west, the Hermit Thrush enjoys perfectly continuous occurrence throughout the coniferous forest; in the east, it is spotty, in smaller enclaves, and seems to limit its occurrence to wetter, brushy parts of the more open coniferous woods. And Swainson's Thrush on the west coast inhabits willows; in the east, it adheres to subalpine coniferous forest. What seems decisive to me is that on the flat top of Table Mountain (1250 feet), near Port-aux-Basques, Newfoundland, and other areas above timberline that I visited in Newfoundland, never were there any Gray-cheeked Thrushes in the abundant, available alder thickets. But I do not therefore declare *minimus* and *aliciae* different species.

WINTER TERRITORIES

Tomás Vargas and I lurked in shady groves with unobstructed vistas of leaf-strewn ground in hopes of seeing natural territorial encounters and foraging on the part of Bicknell's Thrushes in the Dominican Republic. We saw nothing and should in-

stead have watched the narrow dirt road at dusk, as did Mike Entwistle. We rely, therefore, upon indirect evidence and response to faint tape recordings to indicate a territorial behavior just as strong in winter as in summer. Wintering Bicknell's Thrushes that Tomás Vargas and I observed in the Dominican Republic were individually spaced out, and their threatening postures directed at the headphones showed territorial defense. This agrees with studies I made at my home in Altadena, California, on territorial, wintering Hermit Thrushes (*Catharus guttatus*) that I watered with a bird bath and fed with sprigs of toyon berries (*Heteromeles arbutifolia*) beneath shady bushes in my back yard during the 1930s. Each winter an individual owned the territory containing the bird bath and it rested while digesting berries in a bush beside this ground-level bath. The four or five other birds from surrounding territories, including those in neighbors' yards, could bathe only when this individual was not looking. Similarly, considerable discretion was necessary for approaching the toyon sprigs (kept fresh in water in a buried milk bottle), where the local owner would arrive and chase neighbors when he heard their characteristic hopping in the dry *Forrestiera* leaves beneath a long hedge. Thus at least two species of *Catharus*, in my experience, definitely maintain winter territories.

In an earlier paper (Marshall 1988) I reviewed what had been published on winter territories of migrant songbirds. A great deal more has been accomplished by some of those same authors with wintering Wood Thrushes in Veracruz, Mexico, using color bands and radios. Rappole et al. (1989) and Winker et al. (1990) have fine-tuned the concept to include a winter floating population exactly comparable to that unseen contingent on the breeding ground. They have actually seen and identified the floaters (which they call wanderers)—an achievement not easily attained in the nesting season (Marshall 1960 p. 60, "floating population") unless a territorial vacancy is filled. The winter territory for a northern migrant songbird is a fact of life. It can be worked into a unified theory that should explain migration to the Neotropics, group migration, local extinctions in the north, and the loud calls uttered by migrating Swainson's, Gray-checked, and Bicknell's Thrushes throughout the night sky. Rappole and Tipton (1992) have offered just the necessary foundation in their hypothesis of tropical origin of the northern migrants. These birds return to an ancestral home every winter.

GROUP MIGRATION

Based on observations of thrushes and their nocturnal migration, I asserted (Marshall 1988) that all-or-none loss of a population of Swainson's Thrushes from good breeding habitat is due to clear-cutting a corresponding tract of natural vegetation in which the same birds maintain their individual winter territories. A particular enclave of summer has a corresponding area in winter, to which the birds migrate as a group, coordinated by the loud migration whistles characteristic of *Catharus* thrushes. This is confirmed by the distinctive pattern of disappearance wherein one breeding enclave remains intact while a neighboring population utterly disappears. Otherwise we would witness widespread dilution of the species, if northern migrants were not territorial in winter, and if their wandering in mixed flocks in degraded habitat were natural behavior, as so glibly claimed by tropical ecologists.

Bicknell's Thrush is gone from the north shore of the St. Lawrence Gulf, Magdalen Islands, Cape Forchu, Mud Island, Seal Island, and the southwest slope of Mount Mansfield, implying a significant drop in total population. Seal Island, with its 249 ha of prime forest and spruce thicket still ideal for thrushes, would have supported one of the largest continuous nesting populations of Bicknell's Thrush, at least 125 pairs. Haiti, constituting one-third of the former wintering area, has lost virtually all its natural vegetation. It seems perfectly logical to me that these two events are connected. Circumstantial evidence is all we have because no one has looked for Bicknell's Thrush on Haiti before or since the taking of the specimen on 19 January 1928 (Wallace 1939); also, there has been no concerted search at the right time of night upon Seal Island since June 1922. Furthermore, I have been unable to trace the Haitian specimen and those from Seal Island are in worn plumage of midsummer so that it is frivolous to expect or demand that this theory should be substantiated by specimen evidence, even if there were a significant difference in fall coloration between mountain and sea-level breeding populations.

Two direct observations I have on nocturnal activity of Swainson's Thrush support my theory of group migration and can apply as well to *C. minimus*. First, the thrushes call incessantly from all parts of the sky all night long as they maintain full speed and consistent direction. They are obviously keeping in touch with each other. Second, I had an outdoor, uncovered sleeping platform in the woods while attending the summer marine biology course at Friday Harbor, San Juan Islands, Washington, in 1941. Each midnight of 29–31 August I was awakened by the loud, high-pitched migration calls (the clear, rising whistle) of numerous Russet-backed Thrushes (*Catharus ustulatus ustulatus*) in the dense Douglas firs around me. This was the first indication since latter July that any thrushes were still on the island, where they had been in full song during June. On the first two nights they called a while and then subsided, apparently to go back to sleep. But on the last night of August they intensified their calling and presently the chorus of these calls rose aloft and gradually faded away to the south. The following night of 1 September I stood on a Berkeley, California, hill and heard a full sky of migrating Russet-backed Thrushes—merely to show that it was the appropriate time for the activity at Friday Harbor, not that the same colony was involved.

I do not claim such nocturnal group migration for any passerines other than *Catharus ustulatus* and *Catharus minimus* that I have heard loudly calling. Such tremendous outpouring, especially by *ustulatus*, demands an explanation. Why else would they constantly call spontaneously or answer my whistled imitation if not to keep in touch with the group? They are like geese except that these particular two species of thrushes are spread out across the sky instead of flying in a V—all the more reason to call.

ACID CLOUDS

The effect of acid clouds on *bicknelli* habitat is a less simple problem. In 1984 we saw a doomed west slope habitat on Camels Hump; by 1993 it appeared that the dead red spruces were being replaced by thickets of young balsams. Slide

Mountain is proof that *bicknelli* persists at maximum density in pure balsam, for the red spruces that John Burroughs, Kenneth C. Parkes, and Robert W. Dickerman found there are all gone. However the vast expanse of dead conifers on all the southwest slopes of Whiteface Mountain in the Adirondacks is cause for alarums, not only for half the population of Bicknell's Thrush there, but for a whole ecosystem.

WINTER RANGE

The Dominican Republic still provides excellent habitat in many places supporting dense natural woods and forests, all of which, by use of long net lines of up to 20 nets (John Terborgh pers. comm.), have been shown to support the secretive *bicknelli*. These habitats include forested limestone islands protruding from the dense mangrove forests of the northeast (Tomás Vargas pers. comm.). The wintering Bicknell's Thrush population is in good shape in the Republic, particularly as long as the ban on logging the public pine forest in the Sierra Bahoruco stays in effect. The case for wintering in Cuba, especially in the shady woodlands and secondary forests of the east, is that there are too many birds nesting on a hundred or more New England mountaintops (Atwood et al. 1996) for all to fit into the Dominican Republic in winter.

CHANGES IN POPULATIONS

The coniferous habitat still looks ideal for nesting Bicknell's Thrushes at Magdalen, Cape Forchu, Mud Island, and Seal Island. Therefore the extinction of the sea-level, fog belt contingent is most likely due to loss of natural forests on the winter ground, particularly Haiti. Haiti won its race against El Salvador as the first New World country to eradicate its natural vegetation, in the course of which the Seal Island birds would have been dispossessed of their winter territories. Seal Island, of 483 ha and 60% clothed with conifers, is perhaps the largest continuous expanse of habitat anywhere available to the subspecies, planimetered at 249 ha (by Roger Applegate) of forest and thicket all attractive to the bird (Ian McLaren in litt.), and capable of supporting 125 pairs (estimate by Anthony J. Erskine in litt.).

The two skins taken in June 1928 by George M. Sutton at point Natashquan and mouth of the Little Mecatina River are the last trace of Bicknell's Thrush in this taiga of the St. Lawrence's north shore. Dr. Ouellet and I are unable to verify if they represented a significant population.

Development activity on the east face of Mount Mansfield in 1984 included blasting to put in water pipes to supply artificial snow. The thrushes that we censused in 1984 east of the Octagon are gone due to excessive widening of the ski runs—as wide as a highway. The change I assume at Butler Lodge in 1992 might be due to maturing of the conifers, to loss of a winter area in Haiti, or to how you interpret Wallace's book (1939). George Wallace must have been a mountain goat and Martha Wallace likewise may have thought nothing of ascending 1000 feet of altitude to find nests "about Butler Lodge." But we have the evidence of the photo (Wallace 1979) and caption to suggest that the growth immediately behind the

lodge did indeed resemble low *bicknelli* coniferous habitat in 1935. But why would the thrushes give up tall trees at Butler when such groves satisfy them at Whiteface, Mt. Washington, and several places in Newfoundland? I found no *bicknelli* anywhere on the west slope of Mansfield, and none on the east side below 3600 feet in 1992. At Camels Hump in 1984, standing dead red spruce trunks showed in Roger Clapp's panoramic slides that half the habitat (= west slope) was lost, but the same area in 1993 was restored to young fir thickets that sheltered a few Bicknell's Thrushes.

6

CONCLUSIONS

CURRENT POPULATION STATUS OF BICKNELL'S THRUSH

I suggest that aside from the mountaintops of Gaspé and of Carleton Provincial Park, the Canadian population of Bicknell's Thrush is not large. Its great centers of population are in the United States in Baxter State Park, Maine; Mount Washington and its neighbors in New Hampshire; and the Adirondack peaks from Marci to Whiteface in New York. As for Vermont, I had expected that Bicknell's Thrush would be limited to the few highest peaks over 4000 feet, but Atwood et al. (1996) apparently have found them on 25 or more peaks above 3000 feet.

The effect upon the population of acid clouds that destroy red spruce seems to differ from one mountain to another. If the balsam can really return to areas denuded of spruce, as at Slide Mountain, then the thrush habitat is less endangered than if the balsam also dies, as was apparent at Camels Hump in 1984.

TAXONOMIC STATUS OF NORTHERN GRAY-CHEEKED THRUSH, NEWFOUNDLAND GRAY-CHEEKED THRUSH, AND BICKNELL'S THRUSH

All that I have been able to investigate personally in the museum and field convinces me that I should stand by Wallace's (1939) judgement that the Northern and Newfoundland Gray-cheeked Thrushes are one subspecies, *Catharus minimus minimus* (combining *aliciae* with *minimus*) and that Bicknell's Thrush is a second subspecies, *Catharus minimus bicknelli*, of the same species. The Newfoundland population I find to be intermediate in coloration between *aliciae* and *bicknelli*, but because Newfoundland has the oldest name, *Catharus minimus* stands for the whole group.

FIELD-IDENTIFIABLE SUBSPECIES AND THE STUDY OF MIGRATION

The subspecific taxa that can be identified by sight (Appendix 2), including Bicknell's Thrush in conditions where the lower mandible color can be determined, are too valuable a resource (Unitt 1992) to throw away. They can be heard at night and seen on the ground the next morning, enabling us to connect the summer range, migratory path, and winter destination of a distinct population. We can determine changes in numbers from year to year. With no inconvenience to the birds, and immense numbers involved, this sophisticated avenue of research on bird migration should be reinstated along with the museum studies

that are its foundation. These advantages depend on restoring the common names (Appendix 2). Otherwise this rich resource is simply inaccessible to those travelers, amateurs, and recent generation of professional ornithologists who up until now have had no reason to know or care about subspecies.

Other technologies besides resumption of the study of subspecies and counting birds crossing the moon's disk offer dramatic results in migration study. Hanson and Jones (1976) used biochemical analysis of the feathers to identify areas from which geese migrated. Parrish et al. (1983) used trace elements in the feathers to pin down natal areas of falcons. Analysis of stable isotopes of hydrogen that vary by region in feathers acquired there can also link the breeding and wintering grounds of Neotropical migrant songbirds (Chamberlain et al. 1997, Hobson and Wassenaar 1997). Dr. Joseph Jehl finds a genetic and environmental component in the feathers produced by grebes (pers. comm.); the northeast California salt lakes on which they breed leave distinctive chemicals in the feathers. And Bill Evans (pers. comm.) has devised a system that digitally and automatically records voices of nocturnal migrants from microphones in a series of stations crossing New York State. All these methods could well be anchored upon the firm rock of time-tested, verifiable museum technology. Resurrection of museum science need not involve further collecting, but it would certainly restore interest in subspecies, which have the greatest promise for the study of migration.

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APPENDIX 1

Museum specimens of *Catharus minimus bicknelli* examined by Joe Marshall unless credited otherwise. Former collection number as listed by Wallace (1939) is in parentheses. The wing measurement is of the chord, in millimeters; it is not intended for statistics or morphometrics but simply to validate the identification—usually in the one-hundreds for Northern and Newfoundland Gray-cheeked Thrushes but 95 or less for Bicknell's Thrush. Note the long-winged summer specimens, one each from Gaspé and Mt. Washington, both within the nesting area of *bicknelli*. Each of these *minimus* must have fallen short in migration and was accepted into the *bicknelli* breeding population. Wallace (1939) regarded the Gaspé bird as bound for Newfoundland but he did not comment on the one from Mt. Washington. Particulars on netted birds identified as *bicknelli* prior to release appear at the end of this list. Immature means first year, with pale masks on wing coverts.

ACADEMY OF NATURAL SCIENCE, PHILADELPHIA Examined by Mark B. Robbins in 1992.

- 37859 Carter's Dome, 4600 feet, White Mountains, New Hampshire, 1 July 1896, male, wing 94.
37860 Same place, 2 July 1896, male, wing 91.

AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK Examined by Joe Marshall in 1990 and 1992.

- 758364 Seal Island, Nova Scotia, 5 July 1904, female, wing chord 89.
816394 Slide Mt., 3400 feet, Ulster Co., New York, 3 June 1985, female, wing 85.5 (measured by Henri Ouellet, collected by Robert W. Dickerman, who remembers a few red spruces there).
789068 Paget East, Bermuda, 23 November 1957, female immature, wing 86, no fat. [Could it be a late migrant?]
448949 Sanchez, Santo Domingo, 27 December 1906, male, wing 93.
Migrants. Connecticut 376959 (23401), 376960 (33559); New York 48324, 66564, 66565, 66569, 66570, 66598, 67662, 98695–98697, 376961 (2724), 376962 [found by Mary LeCroy], 376963 (47249), 439447 (10687), 439466 (5555), 439467 (1505), 439468 (6458), 439469 (6459), 439470 (11862), 439471

(979), 439472 (1114); New Jersey 181131, 298216 [not seen; is in a permanent exhibit, determined as *minimus*]; Virginia 138963, 138964; South Carolina 56122, 56123.

CANADIAN MUSEUM OF NATURE, OTTAWA

Examined by Joe Marshall in 1989.

- 62216 Lac Mont St. Pierre, Gaspé-Ouest Co., Québec, 24 June 1968, female immature, wing 91.
 62217 Mont Jaques Cartier, 3600 feet, Gaspé-Ouest Co, Québec, 26 June 1968, male immature, wing 94.
 62218 Same time and place, male, wing 94.
 62219 Same place, 3800 feet, 28 June 1968, male immature, wing 88.
 7522 Percé, Gaspé Co., Québec, 16 July 1914, male immature, wing 94.
 8284 Same place, 4 June 1915, male, wing 93.
 8298 Same place, 14 June 1915, male, wing 101. *C. m. minimus* bound for Newfoundland (Wallace 1939).
 8615 Same place, 19 July 1915, female immature, wing 87.
 8616 Same place, 20 July 1915, male immature, wing 94.
 40480 Same place, 12 July 1955, male, wing 96.
 40481 Same place and time, male, wing 95.
 40482 Same place and time, male immature, wing 96.
 71213 8 km NE Popple Depot, 2690 feet, New Brunswick, 18 July 1980, male, wing 93.
 66308 Mont Mégantic, 3500 feet, Canton de Chesham, Québec, 5 July 1977, male, wing 95.

CARNEGIE MUSEUM, PITTSBURG

Examined by Joe Marshall in 1989.

- 102637 mouth of Little Mecatina R., Québec, 27 June 1928, male, wing 94 stripped.
 102539 Point Natashquan, Québec, 2 June 1928, male immature, wing 97 stripped.
 57400 head of Grand Portage [560 m], Ste. Margaret R., Québec, 14 June 1917, male immature, wing 96.
 9479 Fauriel, Grosse Isle, Magdalen Islands, 27 June 1901, male, wing 93.
 9480 Same place, 28 June 1901, male, wing 96.
 135708 summit of Slide Mt., Ulster Co., New York, 5 June 1953, male immature, wing 89.
 135714 Same place, 6 June 1953, male, wing 92.
 135715 Same place and time, female immature, wing 85.

CORNELL VERTEBRATE COLLECTIONS, ITHACA

Examined by Joe Marshall in 1993.

- 23806 Whiteface Mt., 3650 feet, Essex Co., New York, 5 July 1950, male first year, wing 88.
- 23807 Same place and time, 3700 feet, male, wing 94.
- 24151 Same place, 4400 feet, 10 June 1953, male first year (= immature), wing 89.
- 24152 Same place, 4400 ft., 11 June 1953, male, wing 92.
- 21359 Mt. Marcy, 3000 feet, Essex Co., New York, 26 July 1947, male, wing 93.
- 23266 Slide Mt., 4200 feet, Ulster Co., New York, 11 July 1951, female feeding young, wing 85.
- 24155 Same place, 13 July 1953, male, wing 93.
- Migrants. New York 14238, 36688.

FIELD MUSEUM, CHICAGO

Examined by Joe Marshall in 1987 and 1993.

- 146204 (20558) Seal Island, Nova Scotia, 21 August 1909, female juvenile, wing 89.
- 1 (4964) Aguacate, Dominican Republic, 22 February 1895, male adult, wing 96.7.
- 2 (5030) Same place, 25 February 1895, male immature, wing 91.3.
- 26823 Puerto Plata, Dominican Republic, 16 December 1882, male adult, wing 94–95.
- 26824 Same place, 14 December 1882, female, wing 91.9. [Wallace mistakenly used the number 26822 for this specimen. Number 26822 is actually a *C. ustulatus* from Arizona.]
- Migrants. Maine 305451 (6955); Connecticut 146205 (27489), 146206 (11297), 146207 (14287), 146208 (25088), 146209 (18408), 146210 (4948), 146215 (23571), 146216 (9619), 146217 (11447), 146218 (16642), 146219 (2281), 146220 (9647), 146221 (18816), 146222 (17680); New Jersey 70074, 305437 (490), 305452 (496), 305453 (499), 305455 (12670), 305457 (478), 305459 (13394), 305462 (13410); Georgia 143223 (28026), 143224 (28027), 143226 (28857); Florida 70076.
- The male migrant through Cay Sal, Bahamas, 17 May 1891 (Wallace 1939:265) is catalogued as number 7974 but it has not been seen at the Field Museum during the 1900s [because it is not mentioned by Hellmayr (1934:459)]. This is the only specimen documenting the off-continent migration path. I shall appreciate information.

INSTITUTO DE ECOLOGÍA Y SYSTEMÁTICA,

ACADEMIA DE CIENCIAS DE CUBA

Examined by Orlando Garrido in 1993.

- 1332 Botanical Garden of Havana, October 1965, male, flat wing 96.
- 1961 Same place, 26 October 1968, female, flat wing 93.

**MUSEO NACIONAL DE HISTORIA NATURAL,
SANTO DOMINGO**

Examined by Joe Marshall in 1990.

- 75–579 Sierra de Neiba, ~18°37'N, 71°20'W, Prov. Baoruco, Republica Dominicana, 23 February 1975, adult male, wing 93.
- 73–1503 Lechuza de Pilancón, 600 m, ~18°45'N, 69°38'W, Bayaguana, Provence San Cristóbal, Republica Dominicana, 30 March 1973, adult?, damaged, in alcohol, wing 90.

MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE

**Examined by Henri Ouellet in 1992
and by Raymond A. Paynter in 1993.**

- [NOT FOUND] (1448 Townsend) Grand Romain, Labrador [Québec], 8 July 1915, female, wing 90 frayed.
- 257366 (6136 Bent) Seal Island, Nova Scotia, 4 July 1904, female, wing 90.
- 257367 (6137 Bent) Same place and time, female, wing 87.
- 303199 Same place, 29 June 1906, female, wing 89.
- 303200 Same place and time, male, wing 96.
- 312304 Same place, 13 June 1907, male, wing 92.
- 312305 Same place and time, male, wing 93.
- 45834 Yarmouth, Nova Scotia, 8 July year unknown, male, wing 96?
- 207389 (7389 Brewster) Mt. Washington, New Hampshire, 20 July 1882, male, wing 96.
- 207390 (7390 Brewster) Same place and time, male immature, wing 91.
- 297176 (9320 Brewster) Same place, 11 July 1884, male, wing 94.
- 209323 (9323 Brewster) Same place, 1 July 1884, male, wing 91 frayed.
- 209324 (9324 Brewster) Same place and time, female, wing 90.
- 330443 (9325 Brewster) Same time and place, male juvenile, wing 67.
- 324734 (24734 Thayer) Same place, 11 July 1884, female, wing 101. [*C. m. minimus* in the wrong summer station.]
- 324735 (24735 Thayer) Same place and time, male, wing 91.
- 324736 (24736 Thayer) Same place and time, male, wing 89.
- 324737 (24737 Thayer) Same place and time, female, wing 93.
- [NOT FOUND, number unknown] (mounted Howe, Boston Society) Carter's Notch, New Hampshire, 5 September 1899, male immature, wing 90.
- 297178 (12111 Howe, Boston Society) Same place, 2 June 1902, male, wing 90.
- 297127 (30677 Brewster, Boston Society) Mt. Moosilauke, New Hampshire, 22 June 1894, female, wing 85.

- 183873 (——McKechnie) Mt. Madison, New Hampshire, 25 June 1908, female immature, wing 81.
- 190517 (6859) Mt. Mansfield, Vermont, 2 July 1895, female?, wing 85 frayed.
- 190518 (6860) Same place, 3 July 1895, female, wing 84.
- 210145 (10145) Same place, 26 July 1895, male juvenile, wing 82.
- 190520 (3019 Batchelder) Keene, Essex County, New York, 31 July 1889, juvenile, wing 81.
- 275708 Slide Mt., New York, 15 June 1881, collected by Eugene P. Bicknell and presented by Ralph S. Palmer.
- 245796 Greylock, Massachusetts, 6 July 1888, male immature, wing 89.

MUSEUM OF VERTEBRATE ZOOLOGY, BERKELEY

Examined by Joe Marshall in 1987

and wings measured by Carla Cicero in 1992

- 103757 Cape Forchu, Yarmouth Co., Nova Scotia, 13 June 1932, male, wing 96.
- 81004 (1064) Mt. Mansfield, Lamoille Co., Vermont, 22 June 1899, female, wing 93.
- 127690 (3563) Killington Peak, 3000+ feet, Rutland Co., Vermont, 19 June 1929, male, wing 95.
- 127691 (3311) Same place, 2 July 1924, female, wing 87.
- Migrant. Massachusetts 127692.

**MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN,
ANN ARBOR**

Examined by Janet Hinshaw in 1996.

- 113526, Virginia, Princess Anne Co., Norfolk, 2 mi E, F. E. Ludwig, 14 October 1944, Male, chord 96.
- 43531, Florida, Brevard Co., Eau Gallie, W. W. Worthington, 3 May 1910, Male, chord 93 but tip broken off
- 162091, Vermont, Lamoille, Mt. Mansfield, T. D. Burleigh, 22 June 1933, Male, chord 88.5 [on nesting area; the other five are migrants].
- 75228, New Jersey, Essex Co., South Orange, W. E. D. Scott, 2 Oct 1896, Female juvenile, chord 89.
- 75229, New Jersey, Essex Co., South Orange, W. E. D. Scott, 3 Oct 1896, Female, chord 94.
- 201416, West Virginia, Monongalia Co., Morgantown, 1 mi NE, Univ. Farms, W. A. Lunk, 16 May 1940, Female, chord 92.5.

**NATIONAL MUSEUM OF NATURAL HISTORY,
WASHINGTON, D.C.**

Examined by Joe Marshall in 1989.

[I introduce a true *C. m. minimus* specimen here, as identified by the collector, Thomas D. Burleigh, and by Phillips (1991:94—"Breeds in Newfoundland and I. Petit Miquelon") because of its small size and its interest for museum workers looking at specimens of Bicknell's Thrush. It is number 382029 from Little Miquelon Island, a French territory off the south coast of Newfoundland, 20 July 1945, female adult, both wings 95. The bill and feet are large, however. A leading bird enthusiast whom I contacted by phone at Saint-Pierre and Miquelon told me that the species is common there but that he does not know whether the song goes up or down at the end. I have placed the specimen in the same drawer with breeding-area *bicknelli* and Newfoundland Gray-cheeks.]

115026 Grindstone I., Magdalen Islands, 15 July 1887, immature, wings 93/91.

338728 Mt. Mansfield, Vermont, 21 June 1933, male adult, wing 93.9.

338729 Same place and time, 21 June 1933, male adult, wing 90.1.

438235 White Face Mt., New York, 29 July 1910, female, wing 94.9 worn.

438248 High Peak, E. Windham, New York [3524 feet], 19 September 1912, female immature, wing 95.1.

438086 Big Indian Valley, Catskills, New York, 25 June 1909, male immature, wing 90.0. Collected by J. A. Weber, this specimen was traded in about 1996 to Louisiana State University, Baton Rouge, by officers of the Division of Birds, Smithsonian Institution.

Type 95545 Summit of Slide Mt., Ulster Co., New York, 15 June 1881, male adult, wing 93.0.

438282 Slide Mt., New York, 18 July 1925, female adult, wing 89.4.

Migrants. Massachusetts 86660; New York 95546; New Jersey 438181, 438229, 438233, 438239, 439243, 438244, 438249, 438250, 438254, 438261, 438262, 438265, 438266, 438281; Delaware 422403; Maryland 175843, 175844, 385833, 532251, 532275, 564748; District of Columbia 124267, 295836, 573071; Virginia 141572, 236392 (2551), 476468, 481316; North Carolina 357650; Georgia 338727.

NEW BRUNSWICK MUSEUM, SAINT JOHN

Examined by Joe Marshall in 1988.

935 Green River, near Quebec border [=Restigouche County], New Brunswick, June 1960, adult, wing 93.

Migrant. 3660 Chance Harbour, New Brunswick, 4 June 1974, picked up dead in city, female immature, wing 87.4.

ROYAL ONTARIO MUSEUM, TORONTO
From a printout supplied by James A. Dick in 1989.

Migrant. New Jersey 53113 (32314).

HAND-HELD, MARITIME PROVINCES, CANADA

French Mountain, 410 m, Cape Breton, Nova Scotia, spruce and fir forest of medium stature, 16 June 1988, 2130 h, male adult, cloacal protuberance enlarged, 29.5 g., wing 89 with tip worn and frayed, most of mandible orange, side of head gray with no buff, tail concolor with the back. Tape recordings on this bird's territory by Joe Marshall. Photographs by Elsie Marshall.

TV Tower Road, 579 m, 47°26'N, 66°24'W, 4 km north of Devil's Elbow, Nepisiguit River, Northumberland Co., New Brunswick; mixed second-growth immature forest of spruce, fir, birch, with openings of *Kalmia* brush; 27 June 1988, 0700 h, male immature, cloacal protuberance enlarged, 28.5 g, wings 90/91, tail 63.5, tarsus 30.4, culmen 13, tail (reddish) with big growth band and browner than back, pale pointed tips on rectrices, big buff tear-drops rimmed with black on left scapulars (as if replaced while still on a juvenile molt program), some smaller buff tips on right and left greater secondary coverts, mandible (except tip) and gape of mandible and maxilla pale orange, brighter posteriorly on edges of mouth, rest of bill black, feet pinkish to brown on top and ankle, buff soles and heels, patterned lores. Sketches and tape recording in this territory by Joe Marshall. Photographs by Elsie Marshall.

HAND-HELD, NEW YORK: ADIRONDACKS

Little Porter Mountain, 731 m, eastern deciduous forest, Lanyon residence above Keene Valley, 9 September 1992, banded by Wesley E. Lanyon, band number 109 176923, immature, body molt, skull unossified, wing 93. (And on 11 September 1992 in the same net, he banded an immature Newfoundland *minimus*, wing 103.) [Both are migrants.]

HAND-HELD, DOMINICAN REPUBLIC

14 km by road north of Pedro Sanchez, 1500 feet, gallery forest, 18°56'N, 69°06'W, Seiba Province, J. Weske and J. Terborgh netted at least one, 22–24 January 1970.

Alcoa Haul Road, north of Cabo Rojo in the extreme southwest, 14 January 1975. John Terborgh netted six, wing lengths 96, 93, 94, 89, 92, 93; weights respectively 27.5, 30.0, 29.5, 29.0, 30.0, 30.8.

Piedra Blanca, cloud forest, Cordillera Central, 26–28 January 1975. John Terborgh netted six, wing lengths 98, 97, 91, 89, 95, 85; weights respectively 29.0, 30.0, 29.0, 25.6, 26.0, 29.8.

Loma Quita Espuela, 943 m, 19°22', 70°08', Provence Duarte, 3 March 1988. Tomás Vargas saw two and netted one of them.

Forest (montane, humid, broadleaf forest on north slope just below pine forest), 1730 m, above El Aguacate, 18°16'N, 71°41'W, Sierra Baboruco, Prov. Pedernales, 15 February 1990, 09:30 h, adult (no wing spots), wing 88, presumed female (small and belly already bare), tarsus 34, eye dark dull brown of grayish not reddish content, face plain with no pattern, cheeks gray, lores pale gray, corner of mouth and fold from rear of mandible bright orange, rest of mandible (except black tip) and the base and edge of maxilla all ivory with touch of yellow. Sketches showing symmetrical chest spots (Color Plate 1) and tape recording of bird immediately after release, by Joe Marshall. Photographs by Tomás Vargas.

HAND-HELD, PUERTO RICO

Guanica Forest, 25 February 1985, second year, wing 87, 29.3 g. José Colón and Chandler Robbins.

Guanica Forest, 24 January 1985, adult, 25.7 g, wing 88, tail 60.9, tarsus 28.5. Wayne Arendt. The only one in 17 yearly samples of this net line set up by John Faaborg.

APPENDIX 2

FIELD-IDENTIFIABLE SUBSPECIES OF BIRDS

[Field-identifiable subspecies deserving preservation in the literature and recognition, for some, by use of a distinctive common name to facilitate migration studies.]

In the preceding text on Bicknell's Thrush, *Catharus minimus bicknelli*, I remark the loss of that bird's migration route and winter home in Hispaniola (Wallace 1939) when subspecies names were abandoned by the American Ornithologists' Union (1983 contrasted with 1957). The new account of the Gray-cheeked Thrush, *Catharus minimus*, was created de novo, sweeping aside the Wallacean, factual tradition. There has been a flight, a loss, of scientific information since subspecies names were abandoned and since the establishment of a new generation of ornithologists who are unfamiliar with subspecies and have little interest in museum research.

What other species have suffered a similar loss? A change in the classic migration route of the Arctic Tern so as to involve an overland flight is one example (Allan R. Phillips pers. comm.). Loss of the winter ranges of some northern migrants is another (fide A. R. Phillips): Terborgh (1989, figure 11.4) assumed from the 1983 Checklist that the Creepers (*Certhia americana*), Golden-crowned Kinglets (*Regulus satrapa*), and Olive Warblers (*Peucedramus taeniatus*) he saw on Volcán de Colima were wintering birds from the north; actually, the Volcán is south of the winter ranges of migratory populations of those species (AOU 1957). They are endemic populations resident upon the Volcán (Phillips 1986, 1991).

However, the Committee (AOU 1983) did present the differential distributions and migrations of some *groups* of subspecies. Such a "Group," the "Phylogenetic Species" (McKittrick and Zink 1988), and the following major subspecies derived from traditional zoological nomenclature are three names for the same thing. I see no reason to use the new terms, which have no standing in scientific nomenclature.

My rule of thumb for determining populations as members of a single species is that they have similar behavior, ecology, and voice and that they do not overlap in geographic distribution during the nesting season. If they do meet during that season, they may interbreed. "Superspecies," combining those real species that do not meet or overlap, could be a useful term were it not used merely as a cop-out to postpone a decision (American Ornithologists' Union 1983). The list of species that follows this introduction will show by example what I mean by these criteria. The subspecies in the list are those with which I have some personal experience in the field.

Identification of major subspecies is by no means the esoteric exercise with calipers and Ridgway's color standards that older generation splitters (Miller 1931) would have us believe. Gambel's, Nuttall's, and Eastern White-crowned Sparrows (*Zonotrichia leucophrys gambeli*, *Z. l. nuttalli*, *Z. l. leucophrys*) can be told by anyone with good eyes and an ear for music. In migration and in winter, too, these birds sing and show their particular bill colors and head patterns, enabling us to track their various journeys or residencies. The potential infusion of data on whole populations, their status and movement, by people conscious of subspecies who are out there with binoculars and good ears, can be achieved without the slightest inconvenience to the birds.

All I can say about my fascination with subspecies and the neglected benefits from studying them pales by comparison with Unitt's (1992) eloquence. His appreciation of subspecies came from reading Phillips et al. (1964), in which the diagnostic traits of subspecies are set forth. It is I who persuaded Allan R. Phillips to divulge those mysteries in "The Birds of Arizona."

SOME SUGGESTED SUBSPECIES RESTORATIONS, WITH DISTRIBUTIONS AND, FOR SOME, DISTINCTIVE NAMES

Elanus caeruleus leucurus (Vieillot, 1818) White-tailed Kite
Rusty colors on juvenile instead of white as in *caeruleus*. North and South America.

Colinus virginianus virginianus Bobwhite

Colinus virginianus ridgwayi Masked Bobwhite
Black throat instead of white. Not mentioned by American Ornithologists' Union (1983). All *Colinus* are allopatric (Mayr and Short 1970); they could be one species.

Sterna albifrons antillarum Least Tern
Black shafts of primaries instead of white.

[Two Eocene fossils cause the arrangement of shorebirds and geese together, as in Monson and Phillips (1981). The flamingo, *Juncitarsus* has the skeleton of a stilt; and the duck, *Presbyornis* also has the body of a shorebird (Olson and Feduccia 1980 a, b).]

[*Branta*, thanks to Roxie Laybourne:]

Branta canadensis canadensis Canada Goose
Large.

Branta canadensis hutchinsii Richardson's Goose
Medium size.

Branta canadensis minima Cackling Goose
Small.

Branta canadensis leucopareia Tundra Goose
Medium size, darker.

Anas platyrhynchos platyrhynchos Mallard

Anas platyrhynchos diazi Mexican Duck
Hen-feathered.

- Otus asio asio* Eastern Screech-Owl
Whinny, long monotone trill. Rich colors, coarse pattern, red phase. Full gamut from gray to red in Florida and mouth of Mississippi. Browner and denser pattern in Texas. Pale, large, and no red phase in Dakotas.
- Otus asio mccallii* Tamaulipas Screech-Owl
Whinny with curtailed shake, trill markedly inflected. Fine pattern, no red phase.
- Otus kennicottii kennicottii* Western Screech-Owl
Bounding ball song (Hoffmann 1927); double trill in all taxa. Like the Rufous-sided/Collared Towhee problem in its relations with *O. asio*: A few hybrids, mixed pairs, and mixed trios on the Rio Grande and Arkansas Rivers, but overlap without interbreeding in Kerr County, Texas.
- Otus kennicottii xantusi* Cape Screech-Owl
Small, bounding ball; also a short, even call.
- Otus cooperi lambi* Vinaceous Screech-Owl
Small, pink, even call as in *xantusi*.
- Otus cooperi cooperi* Pacific Screech-Owl
Large; even call preceded by a turn; fine pattern.
- Glaucidium gnoma gnoma* Mexican Pygmy-Owl
Small, brown, oak forest, rapid song of doublets.
- Glaucidium gnoma hoskinsi* Thanks to Steve Howell. Cape Pygmy-Owl
Small, brown, tropical woods, slow song of doublets.
- Glaucidium gnoma californicum* Mountain Pygmy-Owl
Large, gray, coniferous forest, slow song of single notes coastal, faster interior (Steve Howell pers. comm.).
- [I do not find the differently colored populations of the Spotted Owl, *Strix occidentalis*, to be distinguishable in the field. Nevertheless, Barrowclough and Gutierrez (1990) would have the Mexican population, *lucida*, a separate species because of one allelic difference at one locus of 23 tested. The Mexican bird, in the hand, shows lots of white markings on the face; the ventral surface between the spots is largely white (Marshall 1995, color plate) instead of the buff of Oregon birds. The California population is intermediate.]
- Strix varia varia* Barred Owl
Who cooks for you, who cooks for you-all?
- Strix varia fulvescens* Fulvous Owl
Who, who cooks f-fer you?
- Aegolius acadicus acadicus* Saw-whet Owl
Patterned in white.
- Aegolius acadicus brooksi* Queen Charlotte Saw-whet Owl
Except on face, the white is replaced by buff (Brooks and Swarth 1925, color plate). Type of *scotea* from Queen Charlotte Islands, 12 December 1896, is a wandering *acadicus* from the mainland.
- Aegolius acadicus ridgwayi* Unspotted Saw-whet Owl
No pattern except on face. Juvenile plumage still unknown, but it should

have black facial disc as in the above two taxa. Hardy et al.'s (1990) claim of specific difference in a sonagram of the only known tape recording is a matter of shape of the individual note, whether inverted "u" for *acadicus* or diamond for *ridgwayi*. Such a difference is within individual variation in other species of owls.

<i>Caprimulgus vociferus vociferus</i>	Whip-poor-will
Smooth voice, spotted eggs.	
<i>Caprimulgus vociferus arizonae</i>	Stephens' Whip-poor-will
Gravel voice, pure white eggs.	
<i>Colaptes auratus auratus</i>	Yellow-shafted Flicker
Black moustache, yellow shafts, gray crown, brown throat.	
<i>Colaptes auratus cafer</i>	Red-shafted Flicker
Red shafts, crown and throat colors reversed.	
[Intermediates in all combinations between these two occur.]	
<i>Colaptes auratus chrysoides</i>	Gilded Flicker
Like cafer but crown cinnamon, shafts yellow (sometimes red).	
<i>Colaptes auratus mexicanoides</i>	Guatemalan Flicker
Back heavily barred with black.	
<i>Sphyrapicus varius varius</i>	Yellow-bellied Sapsucker
Not red on nape.	
<i>Sphyrapicus varius nuchalis</i>	Red-naped Sapsucker
Red on nape.	
<i>Sphyrapicus varius ruber</i>	Northern Red-breasted Sapsucker
All-red head and anterior underparts, few white marks.	
<i>Sphyrapicus varius daggetti</i>	Sierra Red-breasted Sapsucker
Upper parts patterned with white marks, red brighter.	
<i>Dryobates villosus villosus</i> 1766	Hairy Woodpecker
White underparts.	
<i>Dryobates villosus harrisi</i> 1838	Hairy Woodpecker
Brown or smoky underparts.	
<i>Dryobates villosus jardinii</i> 1845	Hairy Woodpecker
Chocolate underparts. [<i>Picoides</i> for Three-toed, <i>Dendrocopos</i> for Pied, <i>Dryobates</i> for Americas—cranial characters, fide Ralph Browning.]	
<i>Dryobates stricklandi arizonae</i>	Arizona Woodpecker
Brown back, big bill, white throat, oaks.	
<i>Dryobates stricklandi stricklandi</i>	Strickland's Woodpecker
White bars down middle of back, small bill, streaked throat, pines.	
<i>Empidonax difficilis difficilis</i> 1858	Western Flycatcher
Pee-eést (Hoffmann 1927).	
<i>Empidonax difficilis cineritius</i>	Western Flycatcher
Pee-eést, dull color, grayed, reduced yellow.	
<i>Empidonax difficilis hellmayri</i> 1935	Western Flycatcher
Wheé-sit.	

- Empidonax difficilis flavescens* 1865 Western Flycatcher
Pec-eést; brighter color. Oaxaca birds (*annectens*) are intermediate in color and geographic range.
- [*Contopus virens* and *C. sordidulus*, Wood-Pewee
(see Browning 1977) Jon Dunn (pers. comm.) finds in Riding Mountain National Park, southwestern Manitoba, that *sordidulus* occupies pine forest of the plateau, whereas *virens* lives in aspens a few miles to the east, on the deciduous forest slope of the eastern descent from the plateau. This is near Clear Lake at 100°00'W 50°40'N. Such habitat restriction is uncharacteristic of *sordidulus* in southwestern states and I would be swayed should Jon Dunn find breeding *virens* to the west of *sordidulus*. Notice that the two taxa have an identical four-syllable phrase that connects the call-notes in a twilight song. I think they are conspecific.]
- Stelgidopteryx ruficollis serripennis* 1838 N. Rough-winged Swallow
Plain, pale.
- Stelgidopteryx ruficollis ruficollis* 1817 S. Rough-winged Swallow
Colored, rusty throat, buffy belly.
- Stelgidopteryx ruficollis ridgwayi* 1901 Ridgway's Swallow
Black on the under tail coverts. See Phillips (1986 with color plate by Anne Pulich).
- Hirundo albifrons albifrons* Cliff Swallow
White forehead.
- Hirundo albifrons swainsoni* Mexican Cliff Swallow
Chestnut forehead.
- Perisoreus canadensis canadensis* 1766 Canada Jay
Plain back, dark belly.
- Perisoreus canadensis obscurus* 1874 Gray Jay
White shafts on back, white belly.
- Cyanocitta stelleri stelleri* 1788 Blue-fronted Steller's Jay
Head and neck black, back sooty or grayish brown
- Cyanocitta stelleri diademata* 1851 Long-crested Steller's Jay
White diadem over eye, head and neck black, back smoke gray.
- Cyanocitta stelleri azteca* Black-crested Steller's Jay
White diadem, head and neck black, back blue.
- Cyanocitta stelleri coronata* 1827 Blue-crested Steller's Jay
White diadem, head and neck blue except sides of head black, back blue.
- Aphelocoma floridana floridana* Florida Jay, Scrub Jay
Short bill, white of the superciliary blends gradually into the pale blue of the crown (Tom Webber in litt.). Streaked feathers, fine throat marks.
- Aphelocoma floridana californica* California Jay
Coarse pattern, brown back, bold colors.
- Aphelocoma floridana woodhouseii* Woodhouse's Jay
Subdued contrasts, blue-gray back, more unicolor.

<i>Aphelocoma floridana texana</i>	Texas Jay
Like California Jay but has white under tail coverts.	
<i>Aphelocoma floridana insularis</i>	Santa Cruz Jay
Large.	
<i>Pica pica pica</i>	Magpie
<i>Pica pica nuttalli</i>	Yellow-billed Magpie
Well, uh, I dunno. Yellow bill, smaller. Nest and eggs identical according to Reed (1904).	
[<i>Corvus imperatus</i> , the Tamaulipas Crow, has a bass voice, like a bullfrog; whereas, <i>Corvus sinaloae</i> , the Sinaloa Crow, has a soprano descending note, like a male California Quail (<i>Lophortyx californica</i>). This is more difference than between the Wood-Pewees; these crows sound like good species to me.]	
<i>Parus rufescens rufescens</i>	Chestnut-backed Chickadee
Rufescent flanks.	
<i>Parus rufescens barlowi</i>	Chestnut-backed Chickadee
Grayish flanks.	
<i>Parus bicolor bicolor</i>	Tufted Titmouse
Gray crest.	
<i>Parus bicolor atricristatus</i>	Black-crested Titmouse
Black crest.	
<i>Aegithalos minimus minimus</i>	Coast Bushtit
Brown.	
<i>Aegithalos minimus plumbeus</i>	Plumbeous Bushtit
Gray crown, pale underparts.	
<i>Aegithalos minimus melanotis</i>	Black-eared Bushtit
Juveniles, and adult males farther south, have black ears.	
[The flocking and foraging behavior and callnotes of Javan <i>Psaltia exilis</i> are so like those of <i>minimus</i> in my experience that I would place them in this same genus as mutually closest relatives (tape recordings, Bioacoustic Archive, University of Florida). <i>A. exilis</i> has a short tail, though.]	
<i>Sitta pusilla pusilla</i> 1790	Brown-headed Nuthatch
Crown brown, larger area of white on nape.	
<i>Sitta pusilla pygmaea</i> 1839	Pygmy Nuthatch
Crown gray, less white on nape.	
<i>Certhia familiaris americana</i> 1838	American Creeper
Brown back, white belly, tawny rump. Type of <i>montana</i> Mt. Graham SI 79550 Henshaw #810.	
<i>Certhia familiaris albescens</i> 1888	Mexican Creeper
Blackish back, smoky belly and chestnut rump.	
<i>Troglodytes domesticus domesticus</i>	House Wren
Grayish chest.	
<i>Troglodytes domesticus brunneicollis</i>	Brown-throated Wren
Orangeish brown chest, pale superciliary, back and flanks barred.	

- Troglodytes domesticus musculus* Southern House Wren
Darker and browner than *domesticus* and without the bars of *brunneicollis*.
- Mimus polyglottos polyglottos* 1758 Mockingbird
- Mimus polyglottos gracilis* Cabanis 1851 Tropical Mockingbird
White wing patch concealed. See Phillips (1986). Unnatural intergrading in Tehuantepec Isthmus, now that the forest is gone.
- Melanotis caerulescens caerulescens* Blue Mockingbird
- Melanotis caerulescens hypoleucus* Blue-and-white Mockingbird
They act and sound the same.
- Turdus migratorius migratorius* American Robin
Western *propinquus* can be distinguished by lack of white tail corners (Allan R. Phillips).
- Turdus migratorius confinis* San Lucas Robin
Pale.
- Turdus migratorius rufitorques* Rufous-collared Robin
More black, and red collar around hindneck.
- Catharus guttatus guttatus* Hermit Thrush
Small, gray flanks, dark grayish-brown back, buff chest.
- Catharus guttatus nanus* Hermit Thrush
Medium size, brown flanks, bright brown back and rich buff chest, also called *faxoni*.
- Catharus guttatus auduboni* Audubon's Hermit Thrush
Large, gray flanks, gray-brown back, whitish chest.
- Catharus ustulatus ustulatus* Russet-backed Thrush
Back reddish-brown, tail redder, spots small and brown; includes *oedicus*.
- Catharus ustulatus swainsoni* Olive-backed Thrush
Back and tail olive (or grayish), spots large and black; includes *almae*. See color plate of these taxa by Marshall (1988).
- Catharus minimus minimus* Gray-cheeked Thrush
Large, back grayish (Alaska) or brownish (Newfoundland), song down at end, winters in South America.
- Catharus minimus bicknelli* Bicknell's Thrush
Small, wing 85–95, back rich olive-brown, yellowish base of mandible, song up at end, winters on Hispaniola. No intergrades with above.
- [*Poliioptila melanura*, the Plumbeous Gnatcatcher, has white outer web of outer rectrix; whereas, *Poliioptila californica*, the California Gnatcatcher is only white-tipped. Differences are explained by Hoffmann (1927), and by Atwood (1988), who discovered overlap in east-central Baja California. He observed 60 pairs of *californica* and 32 of *melanura* in the zone of overlap there and no mixed pairs or hybrids.]
- Vireo atricapillus atricapillus* Black-capped Vireo
Big white patch on face, male black-headed.

- Vireo atricapillus nelsoni* Nelson's Vireo
 Smaller pale patch on face, duller, darker; male hen-feathered—no black cap; wing-bars cream instead of yellow. Size and all vocalisations identical. Breeding range widely separated from *atricapillus*. Looks and sounds like the Ruby-crowned Kinglets (*Regulus calendula*) wintering in the same habitat. Cannot be told in field from female *atricapillus*.
- Vireo solitarius solitarius* Blue-headed Vireo
 Blue head, green back, yellow flanks.
- Vireo solitarius cassini* Cassin's Vireo
 Gray head, duller back and flanks.
- Vireo solitarius plumbeus* Plumbeous Vireo
 All gray and white.
- Vireo virescens virescens* Red-eyed Vireo
 Dull colors
- Vireo virescens flavoviridis* Yellow-green Vireo
 Much brighter colors. I can find no basis for the assertion of overlap with *virescens* in Texas and with *chivi* in Panama (American Ornithologists' Union Committee 1987). South American *chivi* repeats the dull colors of *virescens*. The three populations are allopatric without touching (Phillips 1991).
- Helminthophila ruficapilla ruficapilla* Nashville Warbler
 Lots of yellow.
- Helminthophila ruficapilla virginiae* Virginia's Warbler
 Lots of gray. [The two forms have in different years nested in the same tree in the San Gabriel Mountains but have mostly been separated by the preference of *virginiae* for more brushy, east-slope habitat (fide Kimball Garrett). Jon Dunn (pers. comm.) remarks the longer tail of *virginiae* and states that the still longer-tailed and larger *crissalis* does not wag its tail at all, as the other two definitely do. All three say "pisk." For an accurate illustration of them please see Lanning et al. (1990).
- Dendroica petechia petechia* Golden Warbler
 Chestnut crown of male (Olson 1980).
- Dendroica petechia aestiva* Yellow Warbler
- Dendroica petechia erithachorides* Mangrove Warbler
 Entire head of male chestnut.
 [*Dendroica caerulescens*, the Black-throated Blue Warbler, has, according to Gary Graves (pers. comm.), too much overlap in the dorsal black marks for recognition of *cairnsi*.]
- Dendroica coronata coronata* Myrtle Warbler
 White throat, black cheeks, tup.
- Dendroica coronata auduboni* Audubon's Warbler
 Yellow throat, gray cheeks, chip.
- Dendroica coronata goldmani* Audubon's Warbler
 Yellow throat, back and head black.

- Dendroica occidentalis occidentalis* Hermit Warbler
Yellow face.
- Dendroica occidentalis townsendi* Townsend's Warbler
Patterned face. Siebert Rohwer has intermediates from western Washington (fide Allan R. Phillips).
- Oporornis philadelphia philadelphia* 1810 Mourning Warbler
- Oporornis philadelphia tolmiei* 1839 MacGillivray's Warbler
White eye marks. Hybridize in Alberta (Mayr and Short 1970—studies of G. Cox unpublished).
- Geothlypis trichas trichas* Common Yellowthroat
Gray forehead.
- Geothlypis trichas sinuosa* San Francisco Bay Yellowthroat
Dark back and flanks in fresh plumage. Surrounded by the paler *occidentalis* in the nesting season.
- Geothlypis trichas occidentalis* Common Yellowthroat
White forehead. Compared by Marshall and Dedrick (1993).
- Pheucticus ludovicianus ludovicianus* Rose-breasted Grosbeak
- Pheucticus ludovicianus melanocephalus* Black-headed Grosbeak
[Only limited interbreeding; therefore, Mayr and Short (1970) separate them as two species.]
- Passerina cyanea cyanea* Indigo Bunting
- Passerina cyanea amoena* Lazuli Bunting
Tricolored male, not all blue. [Interbreeding not random; therefore, Mayr and Short separate them as two species.]
- Pipilo erythrophthalmus erythrophthalmus* Red-eyed Towhee
Back of male black, iris red; back of female is brown.
- Pipilo erythrophthalmus alleni* White-eyed Towhee
Same except iris white
- Pipilo erythrophthalmus maculatus* Spotted Towhee
Back and wings spotted with white. [L. Short would add the *ocai* group (Mayr and Short 1970). Orizaba birds have black streaks on greenish back; some with throat feathers basally white.]
- Pipilo fuscus fuscus* Canyon Towhee
Sheddap, warbled song, chest spot, white belly.
- Pipilo fuscus albigula* Cape Towhee
Chip, song of chips, small chest spot, white belly.
- Pipilo fuscus crissalis* California Towhee
Chip, song of chips, no chest spot, dark underparts [in which characteristics and nest and eggs it resembles Abert's Towhee, *Pipilo aberti*.]
- Ammodramus sandwichensis sandwichensis* Savannah Sparrow
- Ammodramus sandwichensis princeps* Ipswich Sparrow
Large, pale brown

<i>Ammodramus sandwichensis beldingi</i>	Belding's Sparrow
Small, blackish upperparts	
<i>Ammodramus sandwichensis rostratus</i>	Large-billed Sparrow
Large bill, brown upperparts	
<i>Aimophila botterii botterii</i>	Botteri's Sparrow
Brownish upperparts.	
<i>Aimophila botterii petenica</i>	Peten Sparrow
Blackish upperparts.	
<i>Aimophila belli belli</i>	Bell's Sparrow
Dark.	
<i>Aimophila belli nevadensis</i>	Sage Sparrow
Pale.	
<i>Junco hyemalis carolinensis</i>	Carolina Junco
Large, bill blue-gray, slate upperparts.	
<i>Junco hyemalis hyemalis</i>	Slate-colored Junco
Small, bill pink, slate upperparts.	
<i>Junco hyemalis aikenii</i>	White-winged Junco
Large, bill pink, gray, white wing bars.	
<i>Junco hyemalis mearnsi</i>	Pink-sided Junco
Medium size, bill pink, head gray, back brown, sides pink.	
<i>Junco hyemalis caniceps</i>	Gray-headed Junco
Small, bill pink, head gray, back reddish brown.	
<i>Junco hyemalis dorsalis</i>	Red-backed Junco
Large, bill black, head gray, back reddish brown.	
<i>Junco hyemalis oreganus</i>	Oregon Junco
Small, bill pink, head black, back brown (Color Plate 2).	
<i>Zonotrichia leucophrys leucophrys</i>	White-crowned Sparrow
Black lores, pinkish brown bill. [Unlike Todd (1953:plate 10), I am not impressed by the dreadful plate upon which the description is supposedly based. See Banks (1964). The type is missing and the type locality was unfortunately restricted to a mixed population. Todd's type of <i>nigrilora</i> is from a north shore area where I could not find the species in 1989. Jean Hoeckwater found White-crowns still breeding as far southwest as Harrington Harbour, but I found none on the opposite mainland from there on west in 1989.]	
<i>Zonotrichia leucophrys gambeli</i>	Gambel's Sparrow
White lores, yellowish bill, unique song, migratory.	
<i>Zonotrichia leucophrys nuttalli</i>	Nuttall's Sparrow
White lores, yellowish bill, resident, Berkeley song is tonic triad, do sol me.	
<i>Passerella melodia melodia</i>	Eastern Song Sparrow
Reddish-brown with black streaks and white belly.	
<i>Passerella melodia rufina</i>	Alaska Song Sparrow
Brown with brown streaks, longer bill, belly not white.	

<i>Passerella melodia fallax</i>	Desert Song Sparrow
Very pale, with brown streaks and white belly	
<i>Passerella melodia heermanni</i>	California Song Sparrow
Dark brown with black streaks and white belly, thick bill developed to an extreme by Suisun Bay <i>maxillaris</i> , which can be identified in a hand-held bird: bill depth 7–8 mm when sighted against a white celluloid ruler.	
<i>Passerella melodia samuelis</i>	San Pablo Song Sparrow
Dusky with black streaks and white belly.	
<i>Passerella melodia pusillula</i>	Alameda Song Sparrow
Yellowish gray with black streaks and yellow belly. Pictured in comparison with some of the above by Marshall and Dedrick (1993).	
<i>Passerella melodia mexicana</i>	Necklaced Song Sparrow
Back dark brown with black streaks, underparts white with rounded black spots arranged like a necklace. See Marshall (1964).	
<i>Passerella iliaca iliaca</i>	Eastern Fox Sparrow
Back reddish and streaked.	
<i>Passerella iliaca unalaschensis</i>	Shumagin Fox Sparrow
Back brown and plain.	
<i>Passerella iliaca schistacea</i>	Slate-colored Fox Sparrow
Back gray and plain. See Barrowclough (1988).	
<i>Loxia curvirostra</i>	Red Crossbill
[Six noninterbreeding, overlapping species with distinctive calls fide Jeff Groth. Perhaps we could distinguish small, medium, and large (<i>stricklandi</i>) in the field?]	
<i>Carduelis pinus pinus</i>	Pine Siskin
<i>Carduelis pinus atriceps</i>	Black-capped Siskin
<i>Carduelis psaltria psaltria</i>	Black-backed Goldfinch
<i>Carduelis psaltria hesperophila</i>	Green-backed Goldfinch
[<i>Sturnella magna</i> and <i>neglecta</i> , Meadowlark. They are good species because of the decisive call-note, which is more conservative than song. Large overlap zone but infrequent hybrids (as contrasted with <i>Colaptes</i>). See Mayr and Short 1970.]	
<i>Icterus galbula galbula</i>	Baltimore Oriole
Head, neck and chest of male black.	
<i>Icterus galbula bullockii</i>	Bullock's Oriole
Superciliary and sides of head and neck orange.	
<i>Icterus galbula abeillei</i>	Abeille's Oriole
Like Bullock's but cheeks and flanks black. They hybridize in Durango (Mayr and Short 1970).	

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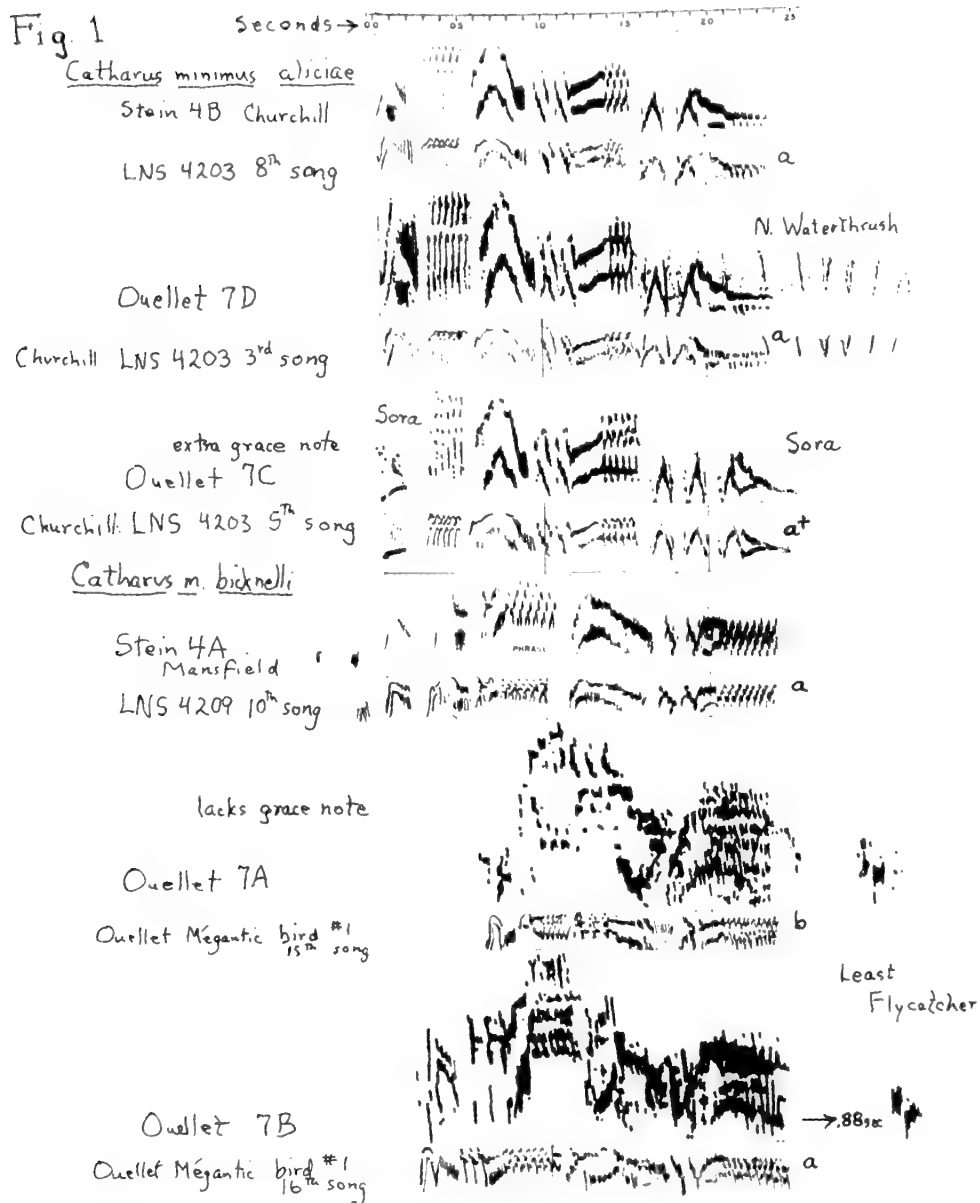
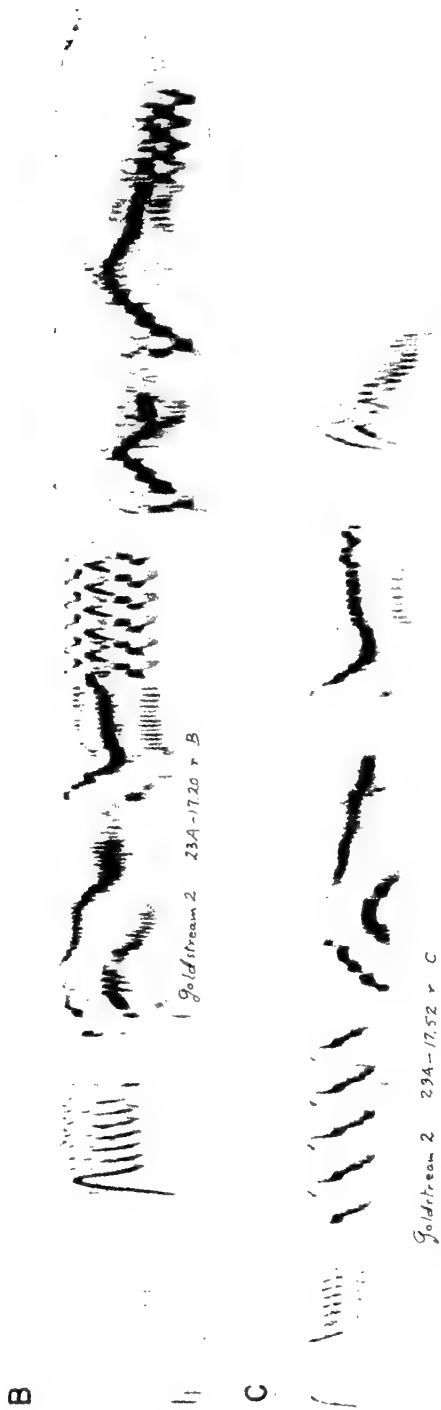
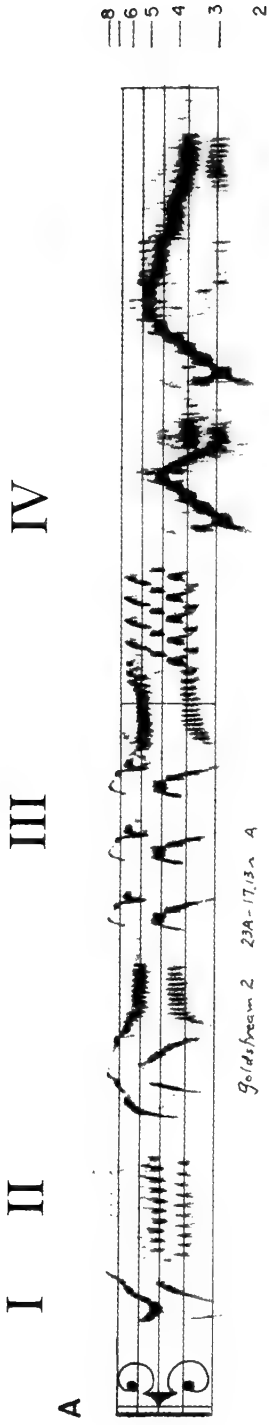


FIGURE 1. Concordance of Published Sonograms

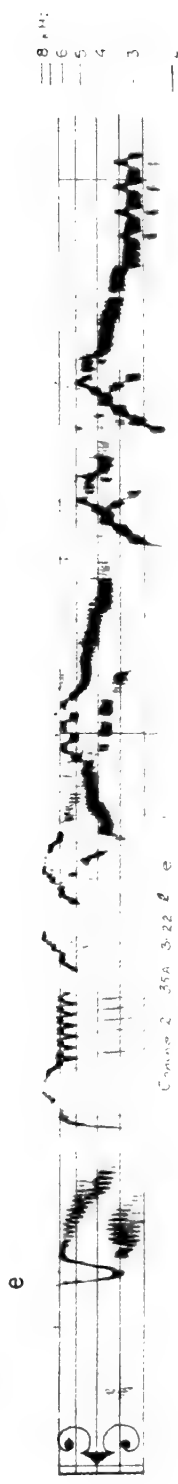


ALASKA *Catharus minimus aliciae* Goldstream 2

FIGURE 2. Exemplary Sonograms of the Three Populations

The C clef is centered on c^3 , the top note of the piano. Each measure is one second.

I II III IV



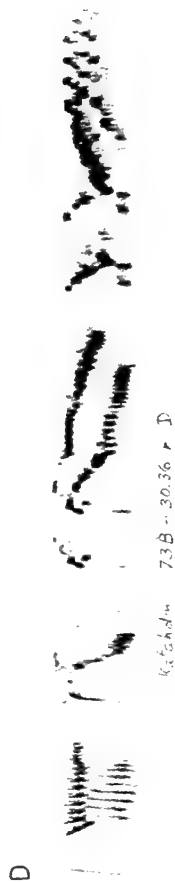
NEWFOUNDLAND

Catharus minimus minimus

Conche 2

FIGURE 2. (continued)

II III IV

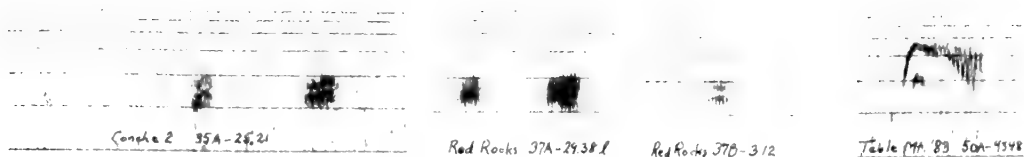


MAINE

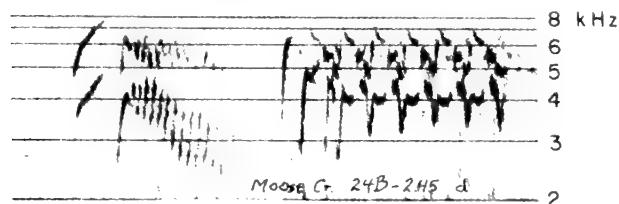
Catharus minimus bicknelli

Katahdin

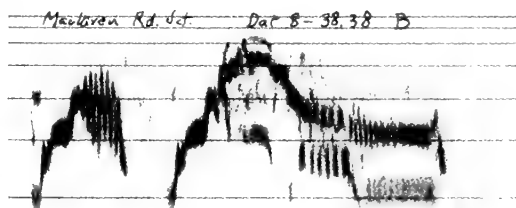
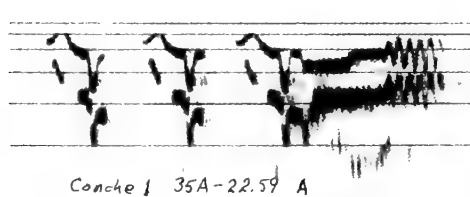
FIGURE 2. (continued)



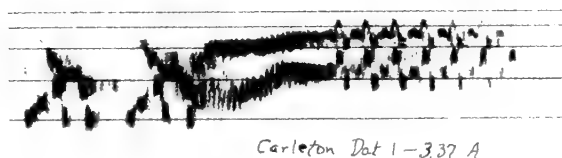
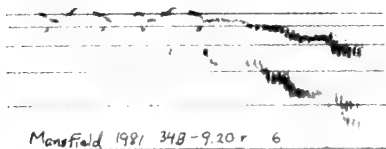
Part I (*minimus*) chucks or lisp



a, the vertical notes (*aliciae*)

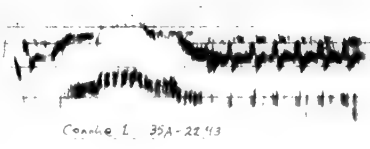
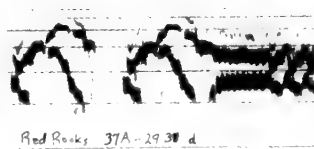
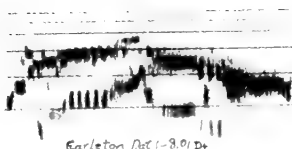


"b rising *minimus* Part IV 'c falling *aliciae*



Part III
'c falling *bicknelli*

Part IV 'b rising *bicknelli*



Part III c² *bicknelli* 'd *minimus* e³ *minimus*

FIGURE 3. Components of the Song

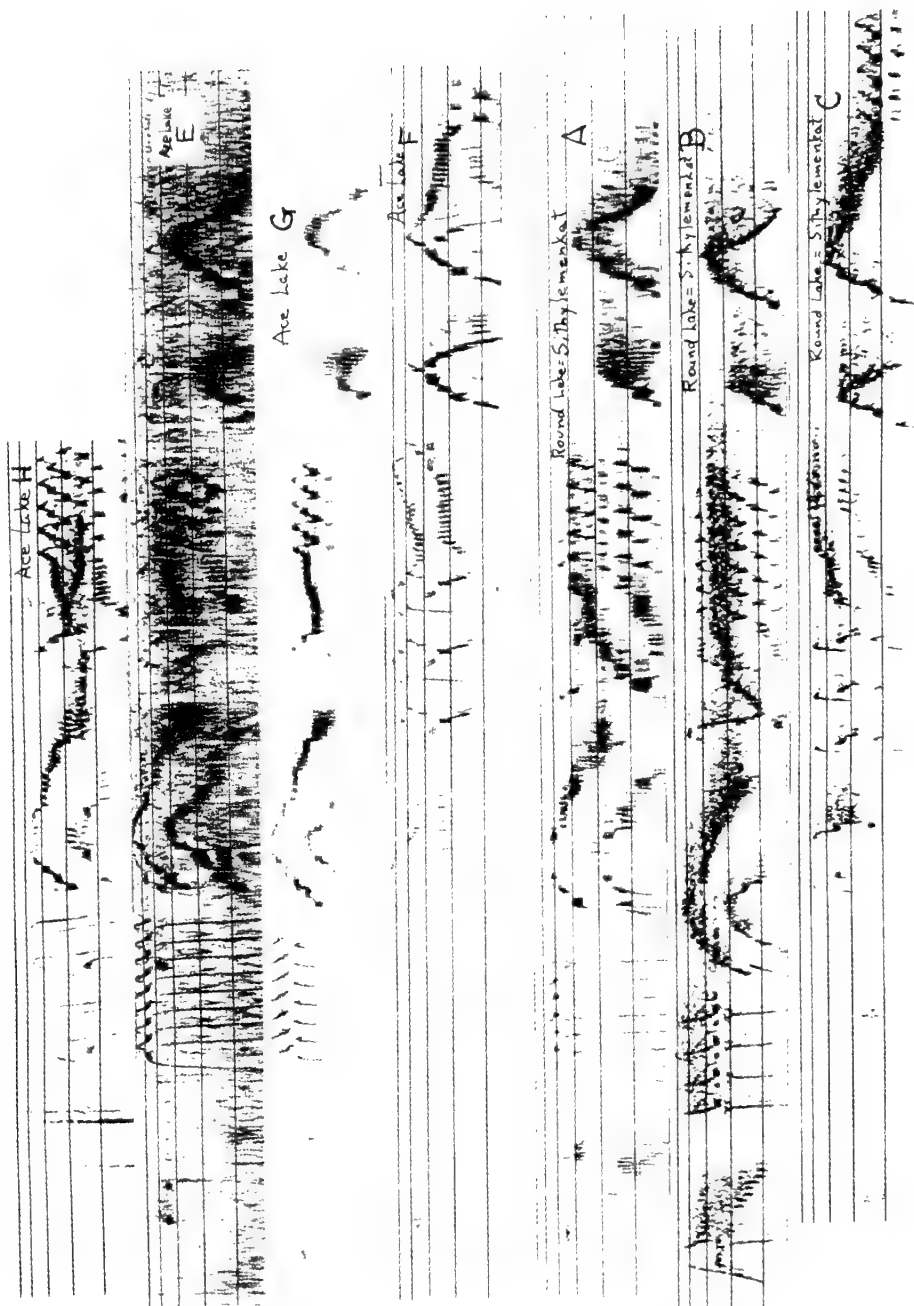
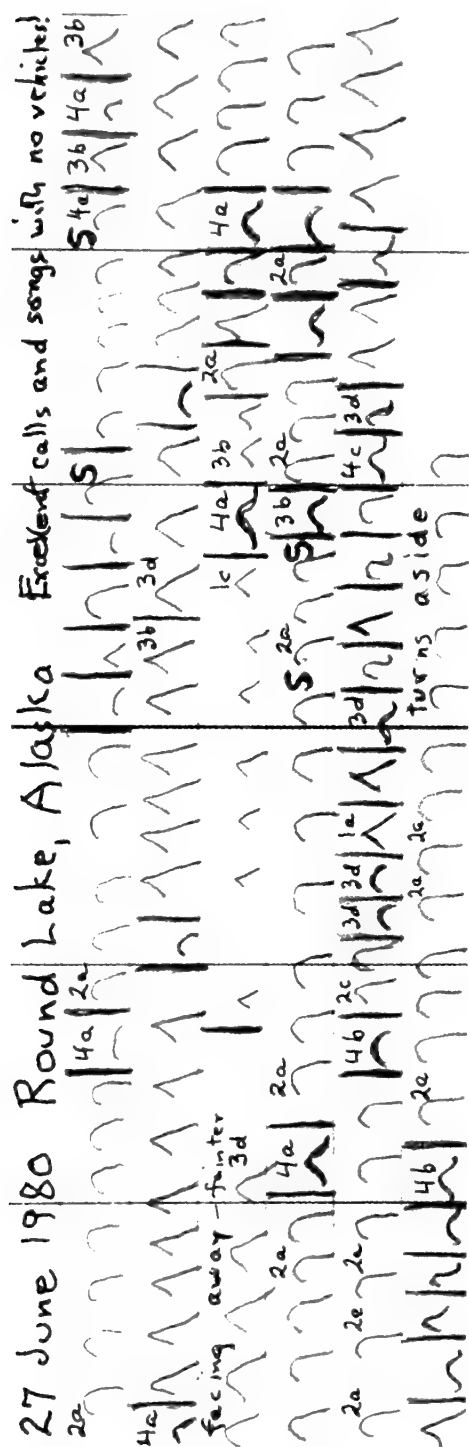


FIGURE 4. Similar Repertoires at Fairbanks (EFGH) and Round Lake (ABC)
E equals A, G is similar to B, and F roughly equals C.



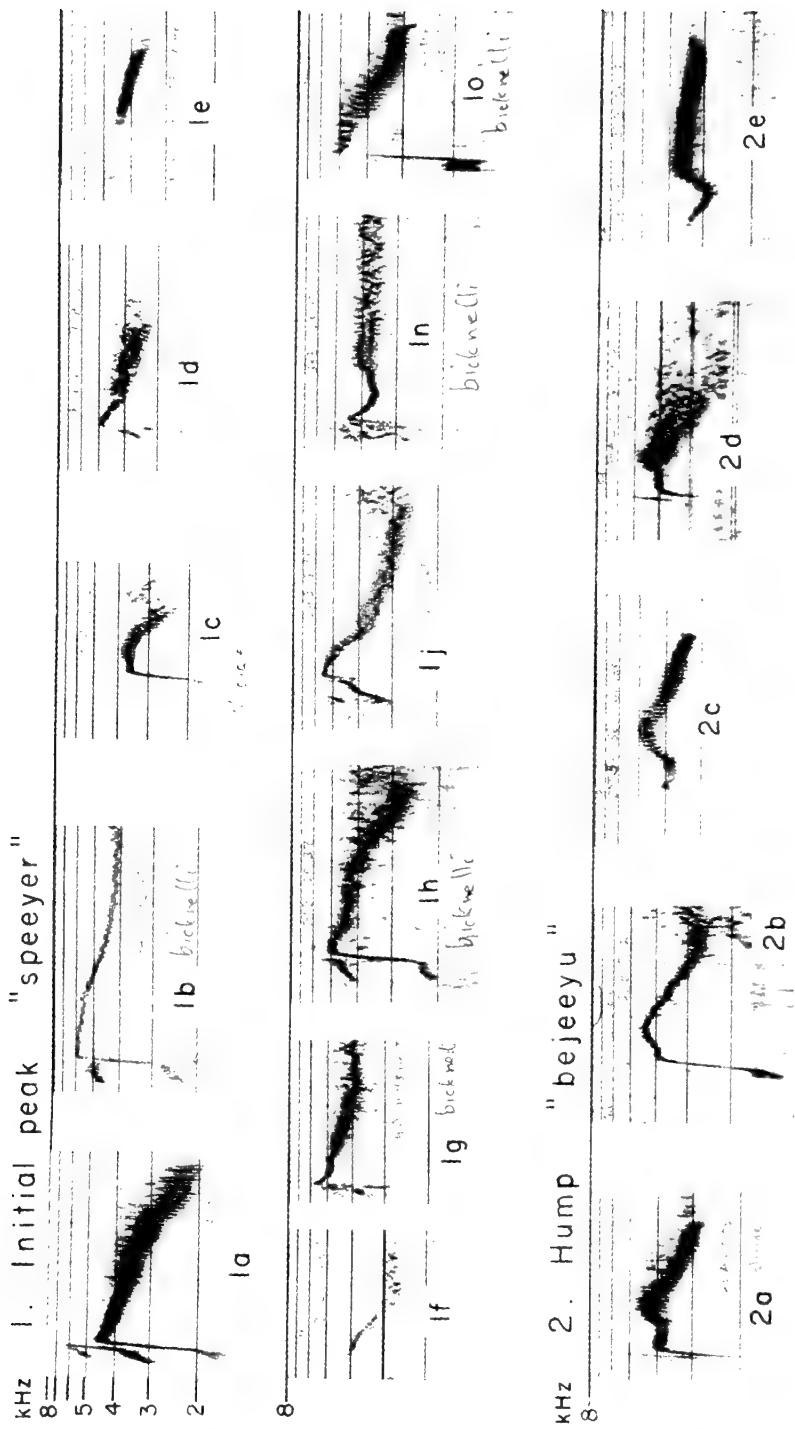


FIGURE 6. Sonograms of the Calls, an Arbitrary Classification

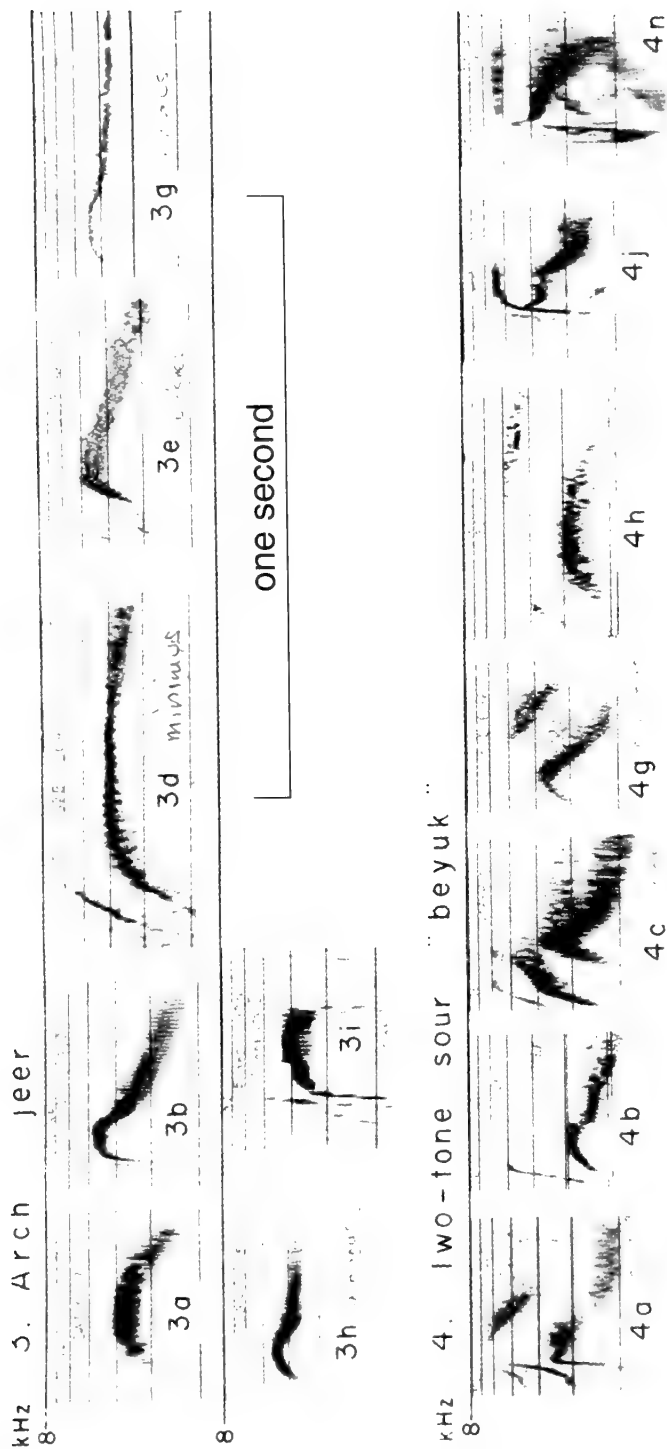


FIGURE 6. (*continued*)

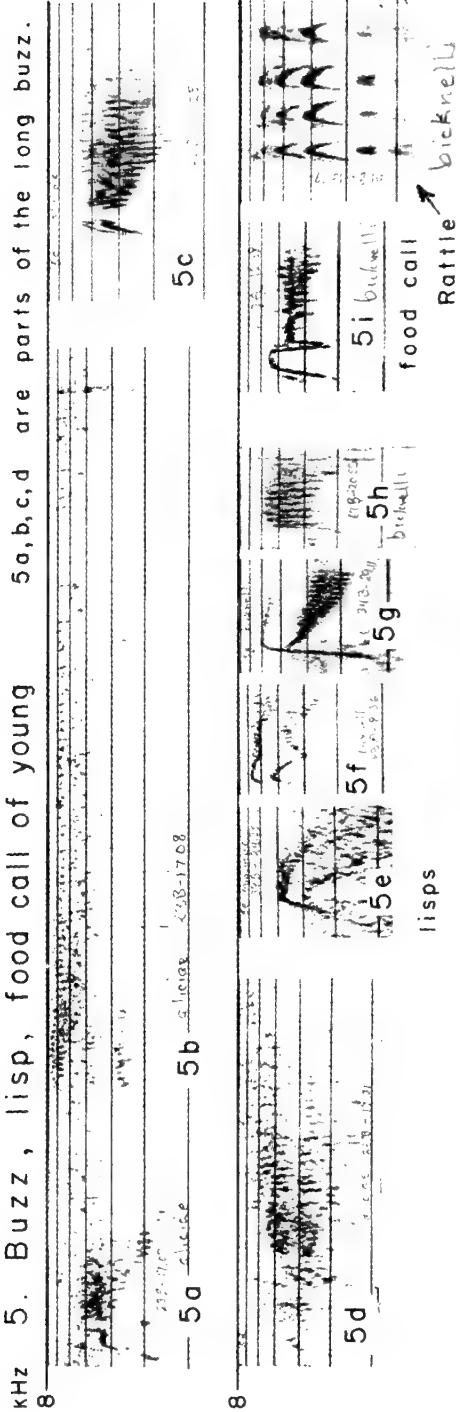


FIGURE 6. (continued)



PHOTO 1. Seemingly Endless Bush Habitat of Gray-cheeked Thrushes at the Maclaren River, Alaska

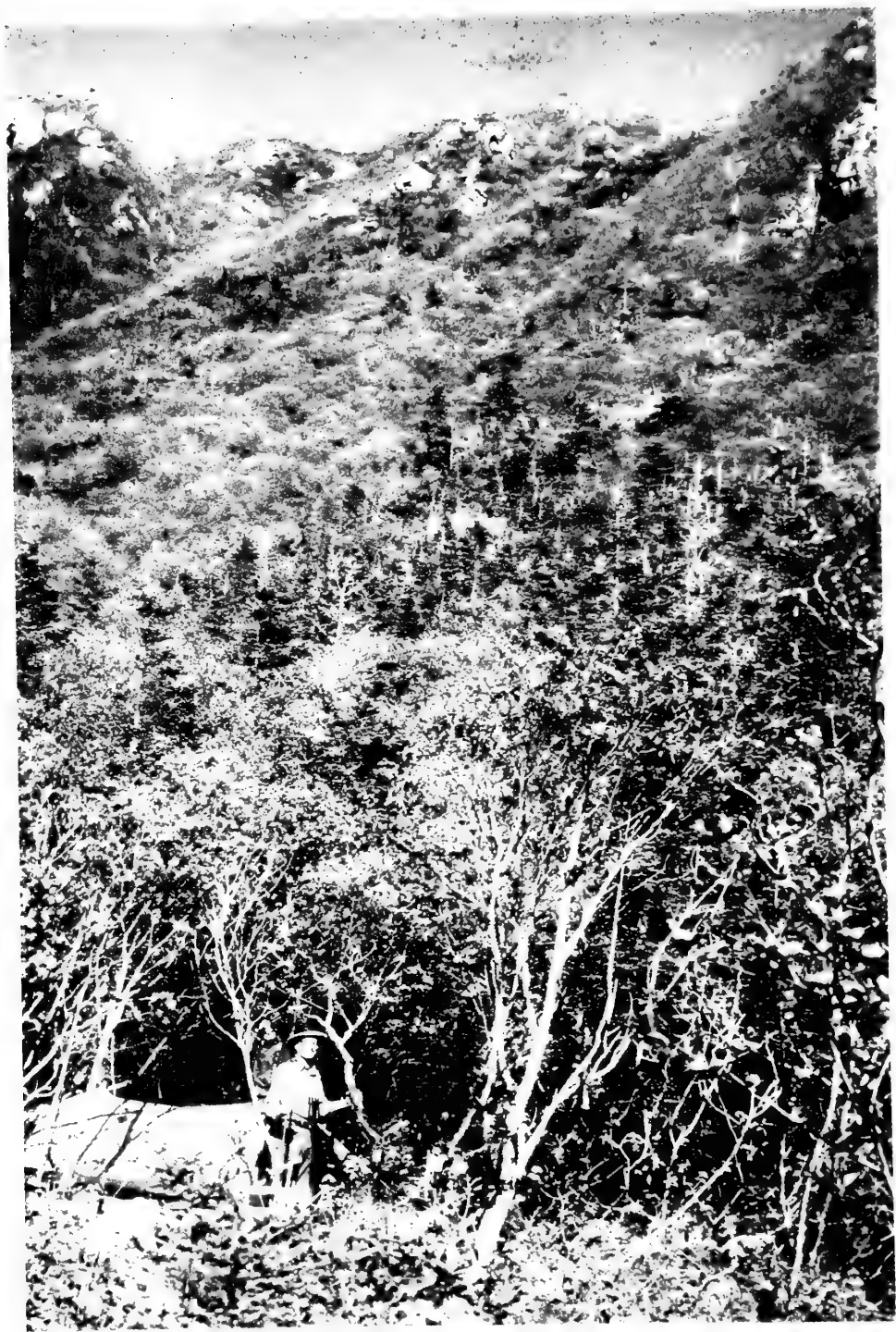
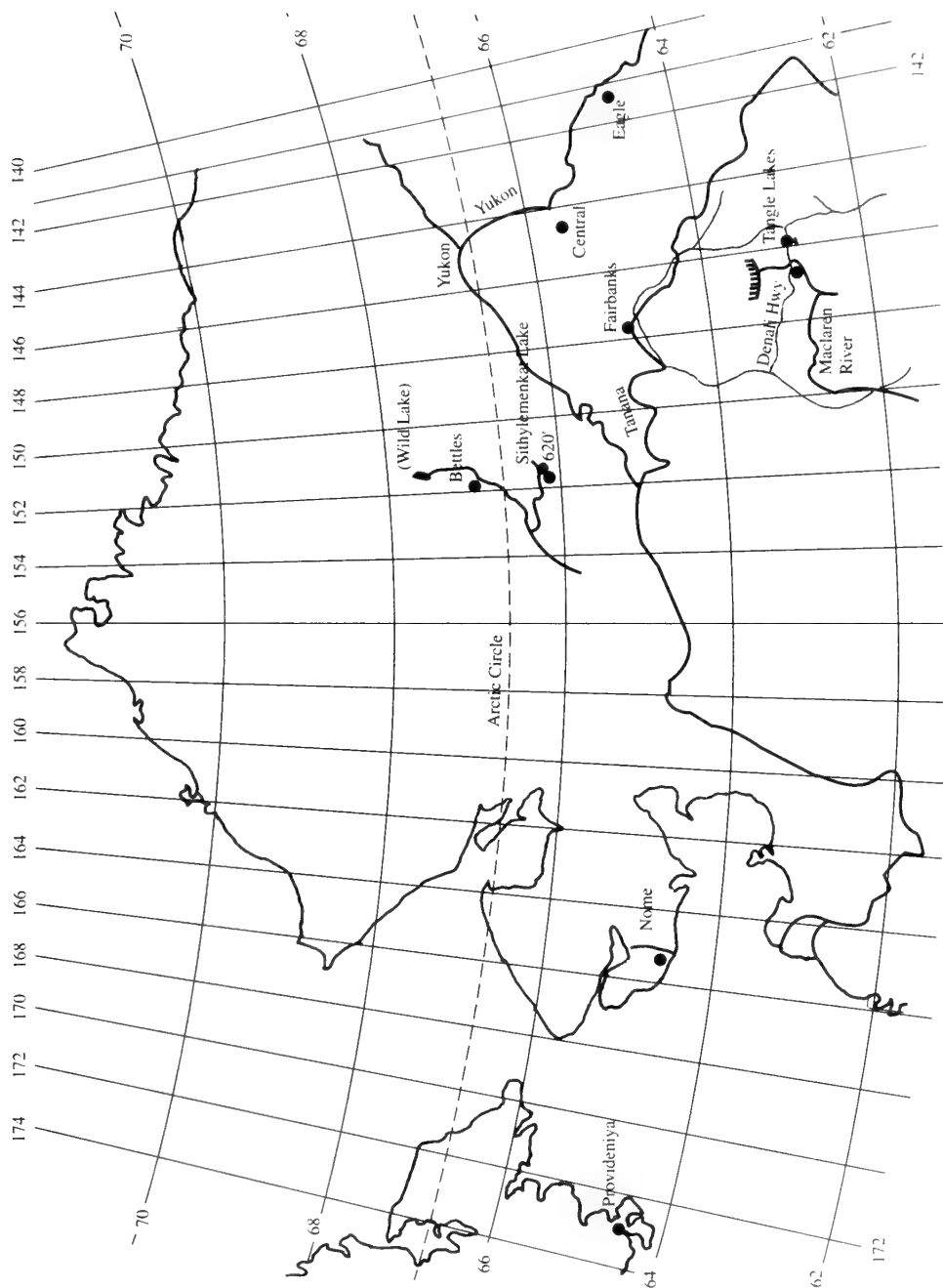
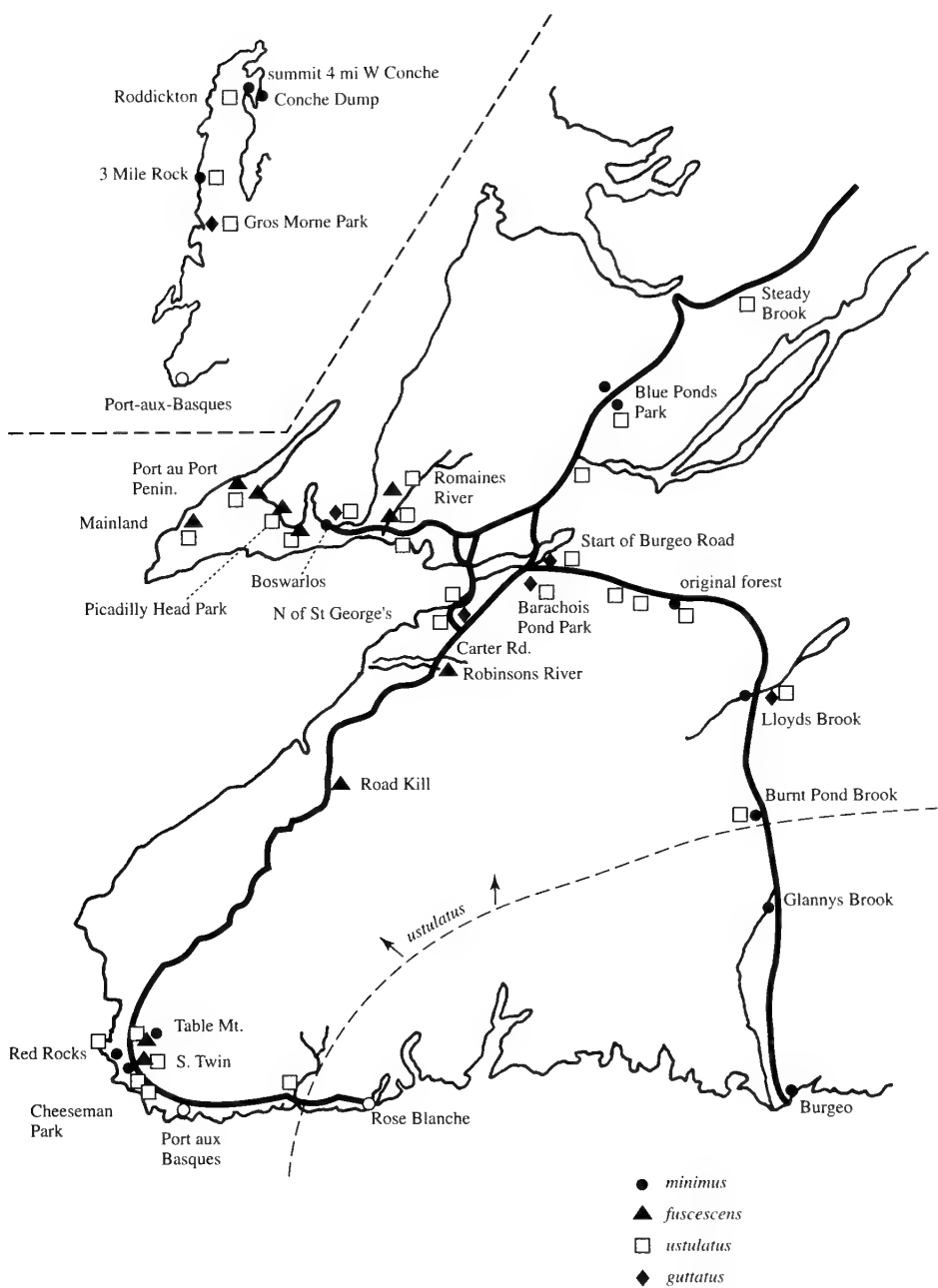


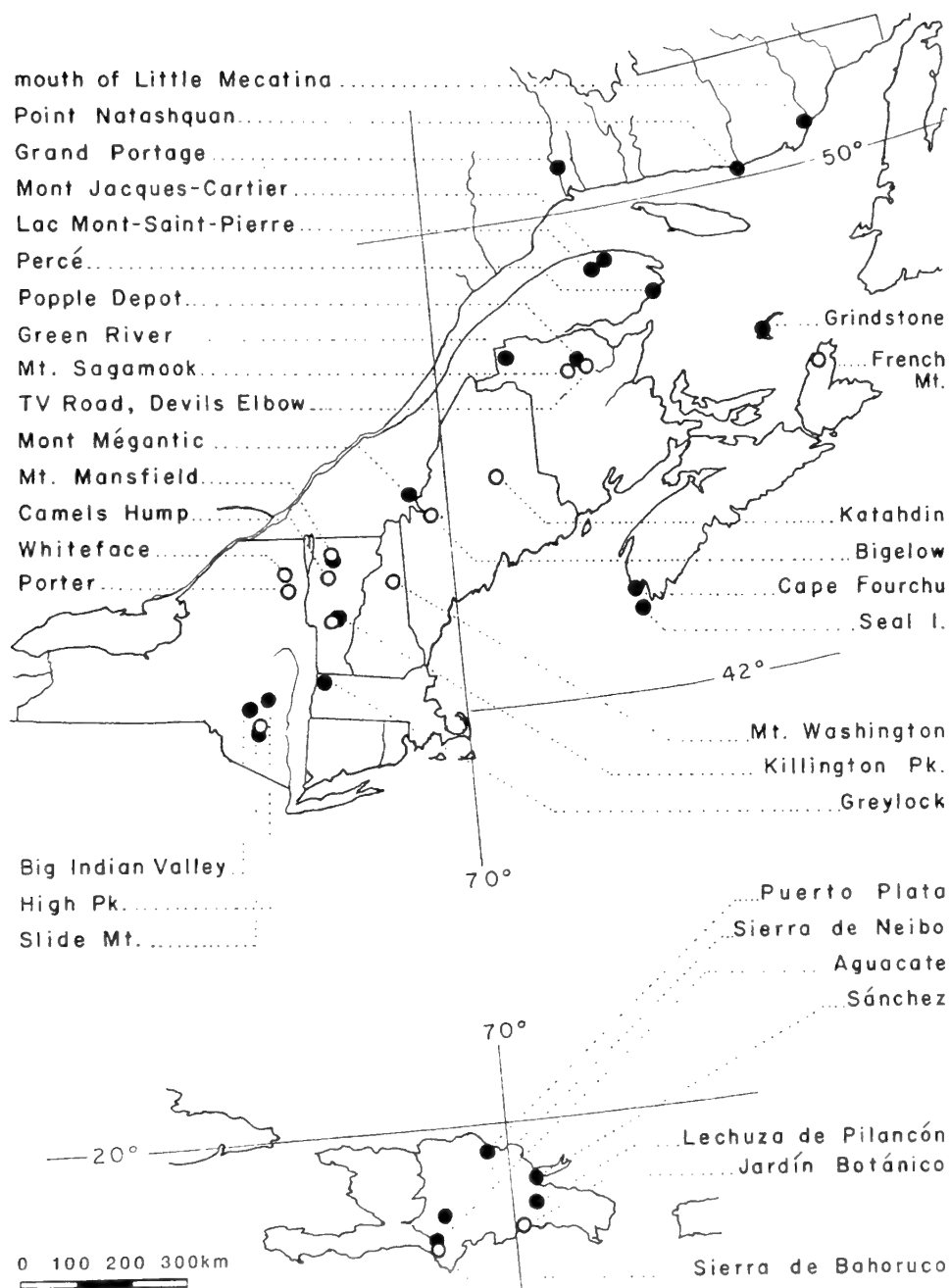
PHOTO 2. Only Known Overlap of Veery and Gray-Checked Thrush—
Beneath Table Mt., Southwestern Newfoundland



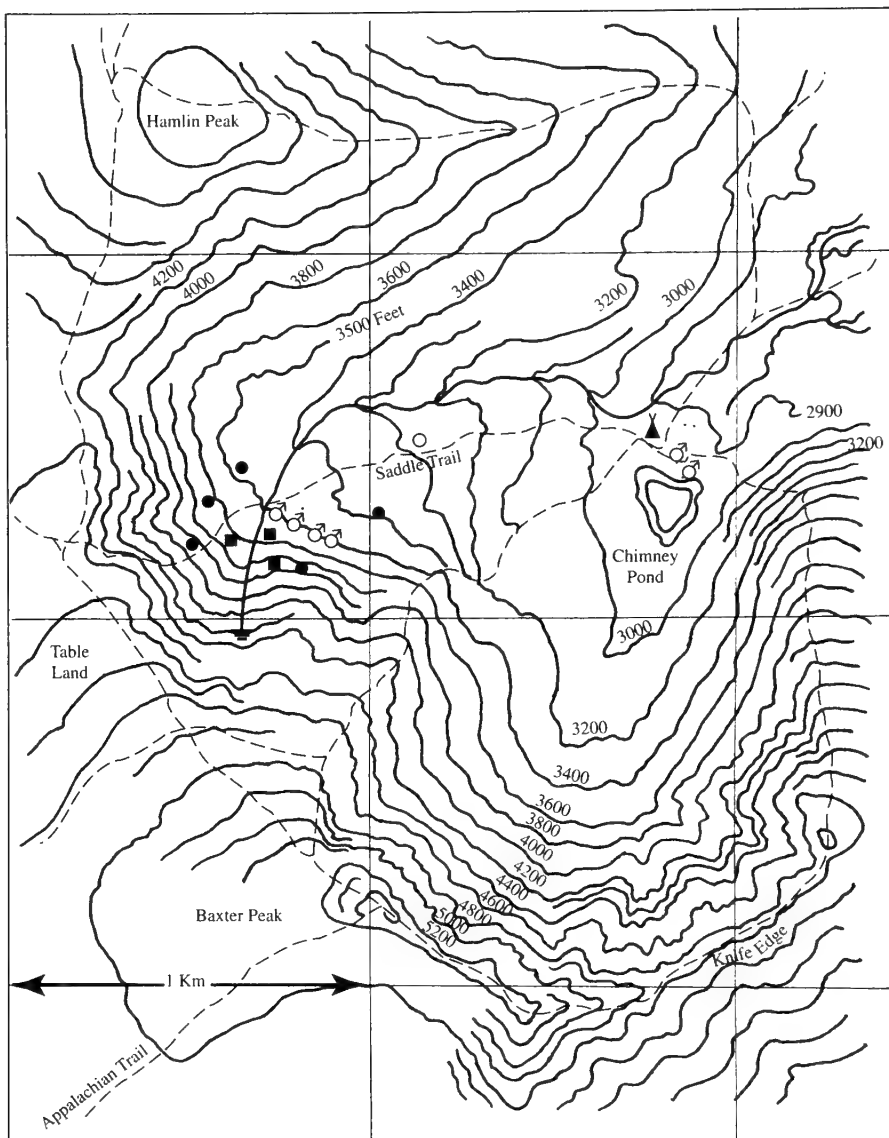
MAP 1. Siberia and Alaska



MAP 2. W. Newfoundland, 1981



MAP 3. Geographic Distribution of Bicknell's Thrush
 From author's field observations (circle) and historic specimens (dot).



9-10 June 1992

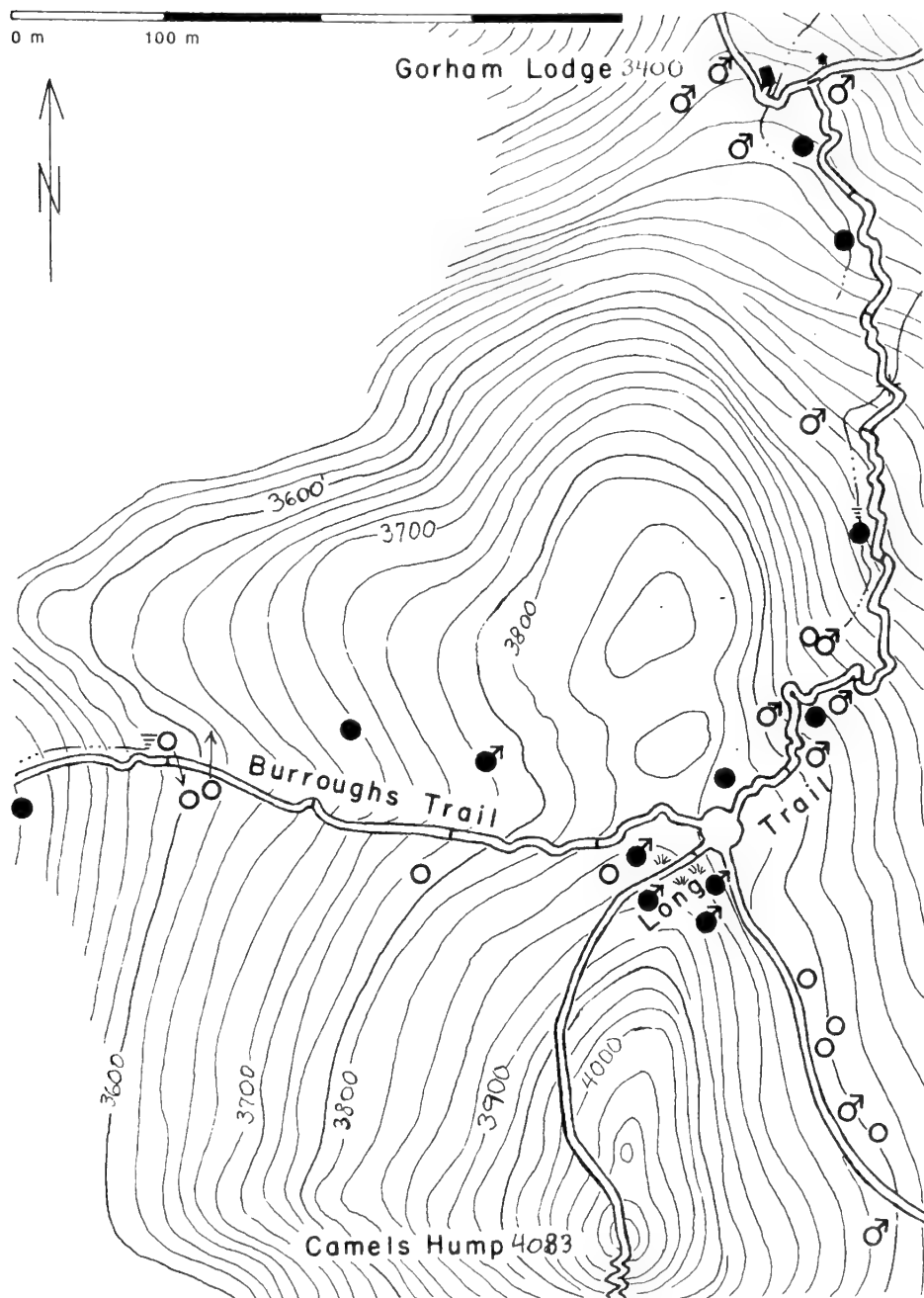
○

20-21 Sept 1994

● = individual calling

■ = family outburst of 4 or 5 birds

MAP 4. Katahdin, Maine



- = Individual Bicknell's Thrush, 30 June - 1 July 1984
- ♂ = Singing Male Bicknell's Thrush, 30 June - 1 July 1984
- ♂ = Singing Male Bicknell's Thrush, 23 - 26 June 1993
- = Individual Bicknell's Thrush, 23 - 26 June 1993

MAP 5. Camels Hump, Vermont

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[illegible]

